SOME STUDIES ON THE MORPHOLOGY AND TAXONOMY OF PLANT PARASITIC NEMATODES OF INDIA

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This is to certify that the research work presented in the thesis entitled "Some studies on the morphology and taxonomy of plant parasitic nematodes of India", by Mr. P. Fazul Rahaman is original and was carried out under my supervision. I have permitted Mr. Rahaman to submit it to the Aligarh Muslim University, Aligarh, in fulfilment of the requirements for the degree of Doctor of Philosophy in Agriculture (Nematology).

Irfan Ahmad
Reader

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INTRODUCTION

Plant parasitic nematodes are one of the most important pests which cause extensive damage to agricultural crops and the loss due to these parasites runs into billions of dollars annually. Besides direct damage, they make host roots more accessible and susceptable to many other types of pathogens like bacteria, viruses and fungi. Most of the plant parasitic nematodes belong to the order Tylenchida and some to Dorylaimida. This study on the plant parasitic nematodes of India is restricted to the morphology and taxonomy of the suborder Tylenchina. Herein also, the Heteroderidae was not included because from the taxonomic point of view this group deserves an exclusive effort.

The plant parasitic nematodes because of their microscopic body size, subterranean habitat and absence of specific symptoms on the plants they feed on, remained unknown to human kind till the middle of the eighteenth century. The first plant parasitic nematode ever reported was Anguina tritici by Needham (1743). Nearly a century later Berkley (1855) reported "vibrios" from galls on cucumber roots, Kuhn (1857) recorded Ditylenchus dipsaci on heads of teasel and Schacht (1859) reported Heterodera on sugarbeet. At about the same time many workers became interested in the taxonomy of soil and free living nematodes which resulted in many excellent publications. Notable among them were Dujardin (1845), Bastian (1865) and Butschli (1873). The taxonomic study of tylenchid nematodes is of recent origin as compared to that of free living nematodes. De Man

(1876, 80, 84 and 1921) published an excellent series of papers on plant and soil nematodes and also proposed a formula for presenting nematode measurements. Orley (1880) and Fuchs (1914, 15) published papers on the taxonomy of tylenchid parasites of plants and insects.

In the early twentieth century many important publications in the form of monographs and books appeared which can be said to be the pace-setters for work on nematology. Cobb (1893-1932) published many important monographs on taxonomy and discovered many new diseases caused by nematodes. His works on taxonomy and techniques formed the basis for a large portion of the methods and apparatus used in Nematology. Filipjev's (1934) book "Nematodes that are of Importance for Agriculture" in Russian language was translated to English in 1941. Taylor (1936) published an excellent monograph on criconematids, while T. Goodey (1933) published the book "Plant parasitic nematodes and the diseases they cause" and in 1951 "Soil and Fresh nematodes" both of which represent important compilations on taxonomy of nematodes. Chitwood and Chitwood's (1937) "Introduction to Nematology" was a landmark in the history of nematology and is still considered as a "classic". Thorne's (1941 & 49) monographs on tylenchid taxonomy are important landmarks in the history of nematology.

After the second world war the descriptive phase of the taxonomy of tylenchids picked up, as is evident from the number

of papers published during this period (Luc et al., 1987). Several books and monographs dealing with Tylenchida were published, viz., Wachek (1955); Ruhm (1956); Meyl (1961); Thorne (1961); Goodey (1963); Paramonov (1962, 68, 70); Decker (1969); Kirjanova & Krall (1969, 71); Heyns (1971); Andrassy (1976); Southey (1978); Dropkin (1980); Maggenti (1981); Nickle (1984); Lamberti & Taylor (1985) and Siddiqi (1986). Of the numerous nematologists who have contributed to the taxonomy and morphology of Tylenchida, some of the more notable ones are Allen, Andrassy, Anderson, Bird, Brzeski, Das, Decraemer, De Grisse, De Guiran, Eroshenko, Fortuner, Geraert, Germani, Golden, Heyns, Hirschmann, Jairajpuri, E. Khan, Krall, Loof, Luc, Mulvey, Raski, Sauer, Seinhorst, Sher, Siddiqi, Skarbilovich, Southey, Tarjan, Van den Berg, Vovlas, Whitehead, Williams and Wouts.

During the last three decades tylenchid taxonomy has undergone repeated and significant changes. Geraert (1966) upgraded Tylenchoidea and Aphelenchoidea to subordinal ranks, Tylenchina and Aphelenchina, and elevated Criconematidae to Criconematoidea. Paramonov (1967) reviewed Tylenchida and upgraded Hoplolaimidae to Superfamily rank. Allen & Sher (1967) divided the order Tylenchida into two superfamilies viz. Tylenchoidea and Aphelenchoidea, eight families and twenty eight subfamilies. Jairajpuri and Siddiqi (1969) upgraded Neotylenchidae to Neotylenchoidea to include five families. Khan (1969)

recognized ten families under Tylenchoidea but did not accept Neotylenchoidea. Golden (1971) classified the order Tylenchida into two suborders viz., Tylenchina, Aphelenchina and listed five superfamilies viz., Atylenchoidea, Neotylenchoidea, Criconematoidea, Tylenchoidea and Heteroderoidea, sixteen families and thirty five subfamilies. Siddiqi (1971) discussed the structural modificatioins of oesophagus in Tylenchoidea and recognized seven families and twenty two subfamilies. Wouts (1973a, 73b) revised the family Heteroderidae and upgraded Meloidogyninae to family rank but disagreed with Golden's (1971) proposal of Heteroderoidea. Andrassy (1976) included under Tylenchida two suborders: Tylenchina and Aphelenchina; Tylenchina with four superfamilies, nineteen families and thirty eight subfamilies; and Aphelenchina with one superfamily, four families and seven subfamilies. Siddiqi (1980 a,b) brought about major changes in classification, Aphelenchina was upgraded to Aphelenchida and Criconematoidea to Criconematina and under Tylenchida. He (l.c.) proposed four suborders viz., Tylenchina, Criconematina, Hexatylina and Myenchina. Maggenti (1981) considered two suborders under Tylenchida viz., Tylenchina and Sphearulariina and one under Aphelenchida viz., Aphelenchina. More recently Maggenti et al. (1987) have proposed four suborders under Tylenchida viz., Tylenchina, Aphelenchina, Sphaerulariina and Hexatylina, and two superfamilies under Tylenchina viz., Tylenchoidea and Criconematoidea. In the present work, the classification scheme

proposed by Maggenti et al. (1987) has been followed.

In India the first plant parasitic nematode (Meloidogyne sp.) was reported by Barber (1901) from tea plantations in South India. Later Butler (1913,19) reported the rice stem nematode Ditylenchus angustus on rice. Dastur (1936) reported the white tip nematode (Aphelenchoides besseyi) of rice. It was only after Siddiqi's (1959) work on nematodes of Aligarh region that organized research on plant parasitic nematodes started. Some of the important contributors to the taxonomy of tylenchids include Siddiqi (1959-66), Das (1960), Jairajpuri (1962-90), Husain & Khan (1967), Khan et al. (1975), Khera (1970); Ray & Das (1978, 80), Edward & Misra (1963, 68), Edward et al. (1965, 71), Siddiqi & Khan (1982, 83), Jairajpuri & Baqri (1973), Chaturvedi & Khera (1979), Kaushal & Swarup (1988). A good amount of taxonomic work, however, is concentrated on other soil nematode groups viz., Dorylaimida and Mononchida.

With the advent of the Scanning Electron Microscope (SEM) the taxonomic studies gained more impetus as it helped in elucidating the finer details of the nematode structure. Based on SEM studies, Stone (1975) divided Heterodera into several groups, Powers et al. (1983) redefined Nagelus, Scutylenchus and Merlinius and Corbett & Clark (1983) emphasized the importance of lip region in Pratylenchus species. Hirschmann (1985) used the shape of lip region in males of Meloidogyne in distinguishing species. Loof (1985) studied lip region of Hemicycliophora species

and discussed its importance in species identification. Germani et al. (1985) studied species of Scutellonema with the help of SEM and emphasized the importance of longitudinal striae on basal lip annule in species identification. Golden (1986) used cyst wall patterns in generic and specific identification of cyst nematodes. Geraert & Raski (1987) and Fortuner & Luc (1987) have used SEM elucidation of the lip regions in generic diagnosis in Tylenchoidea. Numerous authors viz., Mulvey (1974), Sher (1973, 74). Sher & Bell (1975), De Grisse (1979), Hirschmann (1981), Brzeski & Sauer (1982), Van den Berg (1984-92), Vovlas (1983-92), Baujard & Luc (1985), Huang & Raski (1986), Raski & Geraert (1985-86), Geraert & Raski (1988), Othman et al. (1988) and Rahaman et al. (1992) have used SEM extensively not only to supplement light microscopy but also for accurate diagnosis and description of genera and species.

It is unfortunate that despite the fact that the scanning electron microscopy of nematodes first started as early as 1965, yet no publication from India presented SEM visuals till 1991. The primary cause appears to be high cost of the instrument. Even where SEM of Indian species was done, it was by foreign authors (Raski & Luc, 1988; Geraert & Raski, 1988). The first SEM elucidations of nematode morphology from India was by Shafqat et al. (1991) from Aligarh Muslim University. This was followed by series of other papers by Ahmad & Ahmad (1992), Tahseen et al. (1992) and several other authors. However,

descriptions of tylenchid nematodes supplemented with SEM are comparatively few (Rahaman et al., 1992). It was with this in mind that the present work under taken. However, due to certain limitations, SEM of all the species couldn't be carried out.

In the present study 55 species of the suborder Tylenchina were obtained from soil samples collected from several different states of the Indian union. Of this 55 species, descriptions of 32 species have been provided in detail, while for the other 23 species only dimensions and remarks have been given. A detailed description of 17 new species is presented and descriptions of 21 species have been done with the help of SEM. Two known species were recorded for the first time from India.

MATERIALS & METHODS

Soil sampling : Soil samples from around roots of various field crops, fruit trees and flowering plants were collected from various states of union of India. The samples were taken from a depth of 10-25 cm and were kept in polythene bags. All relevant information such as host, locality, date of collection, etc., were noted. The samples were brought to the laboratory for further processing.

Processing of soil samples : The samples were processed by Cobb's (1918) sieving and decantation techniques. About 500 ml soil was placed in a bucket and thoroughly mixed with a small amount of water. The debris and stones were removed and soil lumps, if present, were broken by hand. The bucket was then filled with water to about 3/4th of its volume and then the suspension was stirred to make it homogeneous. The bucket was left undisturbed for about 1/2 a minute to allow the heavy soil particles to settle at the bottom. The muddy suspension was then poured into another bucket through a coarse sieve (2 mm pore size) which retained debris, roots and leaves. The suspension in the second bucket was then poured through a 300 mesh sieve (pore size 53 um). The nematodes and fine soil particles were retained on this sieve. The process was repeated thrice for better recovery of nematodes.

Isolation : The residue on the sieve was collected into a beaker and poured on a small coarse sieve lined with tissue paper. The sieve was then placed on a Baermann's funnel containing water sufficient to touch the bottom of the sieve. Special care was taken to avoid

trapping air bubbles between the bottom of sieve and water level. The stem of the funnel was fitted with a rubber tubing provided with a stopper. The nematodes migrated from the sieve into the clear water of the funnel and settled at the bottom. After about 24 hours, a small amount of water was drawn from the funnel through the rubber tubing into a cavity block. The nematodes isolated as above were fixed and processed for mounting on slides.

Killing and fixation : The nematodes collected in cavity blocks were left undisturbed for a few minutes so as to allow them to settle. Excess of water was removed with a fine dropper and hot TAF (Courtney, Polley & Miller, 1955) was poured into the cavity block. This simultaneously killed and fixed the nematodes.

Mounting and sealing : 24 hours after fixation the nematodes were transferred to a mixture of glycerine-alcohol (95 parts 30% alcohol + 5 parts glycerine) in a small cavity block which was kept in a desiccator containing anhydrous calcium chloride. In about 2-3 weeks the nematodes were dehydrated and ready to be mounted. A drop of anhydrous glycerine was placed on a glass or metallic slide and the nematodes were transferred from the cavity block to this drop. Three pieces of glasswool of same thickness as nematodes were placed around them to prevent flattening. A coverslip was then gently placed on the drop. The edges of the coverslip were sealed with nail polish or putty (Jairajpuri & Rahmani, 1979) or glyceel.

Measurements and drawings : All measurements were made on specimens mounted in dehydrated glycerine with the ocular micrometer. De Man's (1884) formula was used to denote the dimensions of the nematodes. All diagrams were drawn using a camera lucida or a drawing tube.

Scanning electron microscopy : Freshly isolated nematodes were fixed in 3% gluteraldehyde for 90 min, washed in 0.05 m sodium phosphate buffer several times then post fixed in osmium tetroxide for 2 hours at room temperature and washed again repeatedly in buffer. The specimens were then dehydrated in a graded alcohol or acetone series and critical point dried using carbon dioxide as the transitional fluid. Dried specimens were mounted on stubs using a double sided adhesive tape.

Some of the glycerine dehydrated specimens were processed for scanning electron microscopy by the method of Sher & Bell (1975). Glycerine adhering on the surface of specimens was removed by gently touching with filter paper. The dried nematodes were mounted on the edge of a glass chip, which was lightly smeared with glue to hold the nematodes. The glass chips were then fixed to adhesive tape on a stub in an inclined position.

Stubs were coated with 20-30 nm gold in an Eiko 1 B III Ion coater and examined in a Hitachi S-2300 scanning electron microscope at an accelerating voltage of 5-15 kV.

Type material : All type material has been labelled and deposited in the Department of Zoology, Aligarh Muslim University, Aligarh. Some paratypes will be deposited in other nematode collections of the world at the time of publication of the description of species.

In the text um represents µm.

Abbreviations used in the text

L	=	Total body length
a	=	Body length/greatest body width
b	=	Body length/distance from anterior end to the oesophago-intestinal junction.
b'	=	Body length/distance from anterior end to the posterior end of oesophageal glands.
c	=	Body length/tail length.
c'	=	Tail length/body diameter at anus or cloaca.
V	=	Distance of vulva from anterior end X 100/body length.
v-a	=	Distance between vulva and anus.
R	=	Total number of body annules.
Rst	=	Number of annules from anterior end to the base of stylet.
Roes	=	Number of annules in oesophageal region.
Rex	=	Number of annules between anterior end of body and excretory pore.
Rv	=	Number of annules between posterior end of body and vulva.
Rvan	=	Number of annules between vulva and anus.
Ran	=	Number of annules on tail.
VL/VB	=	Distance between vulva and posterior end/body width at vulva.
St%L	=	Stylet length X 100/body length.
Tail/v-a	=	Tail length/distance between vulva and anus.

SYSTEMATICS

ORDER **TYLENCHIDA** THORNE, 1949

Diagnosis : Secernentea. Cuticle distinctly striated (except in Polenchus). Amphids small and pocket-like with pore or slit-like apertures opening on labial or post - labial region. Deirids small and generally indistinct. Stoma with a protrusible spear which is formed by the fusion of the rhabdions, with aperture always opening on ventral side. Excretory system comprises a single lateral canal. Oesophagus consists of a corpus with or without median bulb which may or may not contain valvular aparatus, a narrow isthmus surrounded by nerve ring, and basal glandular portion which may be bulb-like or lobe-like. Dorsal oesophageal gland orifice opens in the procorpus or metacorpus. Reproductive system monoprodelphic or amphidelphic with outstretched ovaries. Testis single, outstretched. Spicules paired, simple, arcuate. Gubernaculum usually present. Bursa present except in Heteroderidae. Tail in both sexes long filiform to short conoid and hemispherical. Phasmids commonly adanal on the tail or erratically on body.

Type suborder : Tylenchina Chitwood, 1950

Other suborders: Aphelenchina (Fuchs, 1937) Geraert, 1966

Sphaeruleriina Maggenti, 1981

Hexatylina Siddiqi, 1980

SUBORDER **TYLENCHINA** CHITWOOD, 1950

Diagnosis : Stoma armed with a protrusible axial stylet (except in degenerate males of some genera), Stylet in males and females

generally with three basal knobs. Lip region distinct or undifferentiated from general body contour. Cuticle striated, exceptionally smooth, transverse annules generally interrupted by longitudinal incisures. Oesophagus composed of a procorpus, metacorpus and a glandular basal portion with an intervening isthmus between metacorpus and glandular region. Dorsal oesophageal gland orifice opens in the procorpus, oesophagus may be tylenchoid, neotylenchoid or criconematoid type. Glandular basal part may be bulb-like or lobe-like. Females with one or two genital branches. Males with or without bursa; when present without ribs. Deirids present or absent.

Type superfamily : Tylenchoidea Orley, 1880

Other superfamily : Criconematoidea Taylor, 1936

SUPERFAMILY **TYLENCHOIDEA** ORLEY, 1880

Diagnosis : (Modified after Maggenti et al., 1987). Lip region generally hexaradiate and distinguished from general body contour, supported by a cuticularized skeleton that may or may not be well developed. Procorpus generally set-off from metacorpus, usually slender and cylindrical. Metacorpus with or without valvular apparatus. Isthmus narrow, leads to basal glandular region. Glandular basal part consists of three glands, ending at the beginning of the intestine or variously overlapping the intestine. Female reproductive system monoprodelphic; didelphic, amphidelphic or didelphic, prodelphic. Phasmids small pore-like, commonly adanal on the tail or

large scutella on the tail or erratically on body. Tail long, filiform, conoid or hemispheroid.

Type family : Tylenchidae Orley, 1880

Other families : Anguinidae Nicoll, 1935
Dolichodoridae Chitwood, 1950
Belonolaimidae Whitehead, 1960
Pratylenchidae Thorne, 1949
Hoplolaimidae Filipjev, 1934
Heteroderidae, Filipjev & Schuurmans Stekhoven, 1941

FAMILY **TYLENCHIDAE** ORLEY, 1880

Diagnosis : (Modified after Geraert & Raski, 1987). Usually slender, elongate, small species. Sexual dimorphism absent. Stylet usually small, delicate. Oesophagus with slender procorpus, median bulb more or less developed; long, slender isthmus, oesophageal glands symmetrically arranged, pyriform, rarely with slight overlapping on intestine. One female gonad, prodelphic; rarely two gonads, amphidelphic. Columned uterus with four rows. Tail long, conoid to filiform. Bursa small, adanal, occasionally absent.

Type subfamily : Tylenchinae Orley, 1880

Other subfamilies : Ecphyadophorinae Skarbilovich, 1959
Tylodorinae Paramonov, 1967
Atylenchinae Skarbilovich, 1959
Boleodorinae Khan, 1964

SUBFAMILY **TYLENCHINAE** ORLEY, 1880

Diagnosis : (Modified after Geraert & Raski, 1987). Cuticle finely to coarsely striated, exceptionally without striations. Lateral fields with 2 to 12 lines, rarely without lines. Head continuous or slightly offset, amphidial apertures pore or slit-like (slit may be transverse or longitudinal), usually oral disc absent. Stylet small to very small with knobs. Female genital tract short with only three or four cells in each of the four rows of the crustaformeria part of uterus. Tail elongate, tip variously formed.

Type genus : Tylenchus Bastian, 1865

Other genera : Filenchus Andrassy, 1954
Miculenchus Andrassy, 1959
Irantylenchus Kheiri, 1972
Malenchus Andrassy, 1968
Allotylenchus Andrassy, 1984
Polenchus Andrassy, 1980
Cucullitylenchus Huang & Raski, 1986
Tanzanius Siddiqi, 1991

TYLENCHUS BASTIAN, 1865

Diagnosis : Small to medium-sized (0.4-1.3 mm), ventrally curved upon relaxation. Cuticle moderately thick, distinctly annulated. Lateral fields each with four incisures. Phasmids dorso-sublateral, post-median, just behind vulva. Cephalic region continuous, annulated, framework with light or no sclerotization. Amphidial apertures large, pit-like, confined to labial plate. Stylet 8-21 um long, with conus about half of stylet length and round, posteriorly sloping basal knobs. Median oesophageal bulb oval, muscular with refractive valve plates, anterior to middle of oesophagus; basal bulb pyriform. Cardia distinct. Excretory pore usually opposite basal bulb. Deirids just behind level of excretory pore. Vulva a transverse slit, usually at 60-70% of body length, lips not modified; epiptygma or lateral membranes absent. Vagina generally at right angle to body axis. Post-vulval uterine sac about body width or less long. Spermatheca round to oval, offset. Ovary outstretched. Tail ventrally arcuate, often hooked, regularly tapering to a pointed or minutely rounded terminus. Bursa adanal, margins crenate. Spicules cephalated, arcuate, 13-25 um long. Gubernaculum simple, fixed. Cloacal lips slightly raised, anterior lip pointed, posterior usually rounded, not tubular. Hypoptygma absent.

Type species : Tylenchus davainei Bastian, 1865

TYLENCHUS RITAE SIDDIQI, 1963

Measurements

Females (n=12) : L=0.70-0.75 (0.73±0.02) mm; a = 35-39 (37.2±1.3); b = 6.4-7.7 (6.8±0.43); c = 4.6-5.2 (4.9±0.2); c' = 10.7-12.2 (11.0±0.45); V = 59.0-62.8 (60.3±1.5); stylet = 15.0-16.5 (15.7±0.75) um; conus = 7.5 um; oesophagus = 93-114 (107.0±7.8) um; excretory pore = 90.0-100.5 (94.5±3.7) um; v-a = 143-150 (146.6±3.4) um; tail = 140-165 (149.0±8.6) um; tail/v-a = 0.93-1.14 (1.01±0.06).

Males : Not found.

Host and locality : Soil around the roots of forest tree (unidentified) from Tinsukhia, Assam.

Remarks : The present specimens agree with the measurements and description of Tylenchus ritae, but have more slender body, median bulb located posterior to middle of oesophagus (MB = 54-61%) and v-a distance almost equal to tail length (a = 29-34, median bulb almost in the middle of oesophagus and v-a distance more than tail length in original description given by Siddiqi (1963a).

FILENCHUS ANDRASSY, 1954

Diagnosis : Head sclerotization delicate. Stylet usually less than 15 um, conus less than half stylet length. Transverse striae usually extend to head upto small labial plate which is squarish with rounded corners; four cephalic sensilla present or absent. Amphidial apertures usually elongate slits beginning near oral disc or at edge of labial plate, extending laterally through three or four head annules, rarely small elliptical apertures confined to labial plate. Body annules fine to coarse. Lateral fields with two to four lines. Tail elongate conoid, curved or straight, to effiliate/filiform even hair-like in out line.

Type species : Filenchus vulgaris (Brzeski, 1963) Lownsbery & Lownsbery, 1985

FILENCHUS SANDNERI (WASILEWSKA, 1965) RASKI & GERAERT, 1986

(Fig. 1)

Measurements

Females (n=6) : L = 0.42-0.50 (0.46±0.03) mm; a = 31.2-38.2 (35.3±3.0); b = 5.4-6.2 (5.8±0.34); c = 47-52 (48.8±2.3); c' = 5.7-6.3 (5.9±0.25); V = 74-77 (75.0±1.2); stylet = 8.5 um; conus = 3.0 um; oesophagus = 79-84 (80.1±1.2) um; excretory pore = 58-62 (60.5±1.8) um; v-a = 62-78 (67.4±7.5) um; tail = 47-52 (48.8±2.3) um; tail/v-a = 0.66-0.75 (0.7±0.03).

Males (n=4) : L = 0.49-0.53 (0.50±0.01) mm; a = 39-42 (40.4±1.2); b = 6.0-6.5 (6.3±0.2); c = 8.7-9.4 (9.0±0.3); c' = 6.0-6.2 (6.05±0.08); stylet = 8.5 um; conus = 3.0 um; oesophagus = 82-88 (85.3±2.2) um; excretory pore = 61-64 (63.0±1.4) um; spicules = 15-18 (16.2±1.2) um; gubernaculum = 7.0 um; bursa = 21-27 (23.0±2.8) um; tail = 54-57 (55.8±1.2) um.

Description

Female : Body small, slender, slightly arcuate to C-shaped upon relaxation, narrow at head and tail ends. Cuticle finely striated, each striae less than 1.0 um apart at midbody. Lateral fields with four lines, 1/3rd body width wide at midbody, originating near metacorpus. Lip region continuous, blunt anteriorly, 6-7 um wide, 4 um high, very faintly striated. Amphidial apertures inconspicuous. Cephalic framework conspicuously developed. Stylet slender, weak; conus about 1/3rd of stylet length. Opening of dorsal oesophageal gland 1.3 um behind spear base. Oesophagus with tubular, 15-20 um long procorpus. Metacorpus oval, muscular with 3 um long valve plates, located anterior to middle of oesophagus. Isthmus very slender, 23-28 um long. Basal bulb pyriform, 16-20 um long, 8 um wide. Cardia hemispherical, 2 um long. Nerve ring 48-53 um from anterior end. Excretory pore near base of isthmus. Hemizonid anteriorly adjacent to excretory pore.

Gonad monoprodelphic, outstretched. Oocytes in a single row. Vulva a transverse slit, vagina muscular, 40% vulval body width

deep. Uterus tubular, muscular. Spermatheca oval, 12.0-16.5 um long. Post-uterine sac less than vulval body width long. Vulva-anus distance 1.3-1.5 times tail length. Tail arcuate, elongate conoid, with round terminus. Phasmids indistinct.

Male : Similar to females. Spicules well developed, strongly ventrally curved, captitulum elongated. Gubernaculum simple, arcuate. Bursa adanal with finely crenate margin. Tail similar to female.

Host and locality : Soil around the roots of rose (Rosa indica) from Aligarh, Uttar Pradesh.

Remarks : Filenchus sandneri was first described by Wasilewska (1965) as Tylenchus sandneri. Raski & Geraert (1986a) on the basis of shorter conus shifted it to Filenchus. The present specimens conform well with the original description except in having conspicuous sclerotization in cephalic region and a slightly longer oesophagus. It was also observed that lateral lines originated at the metacorpus region.

MALENCHUS ANDRASSY, 1968

Diagnosis : Head elevated, dorso-ventrally compressed, labial plate rectangular showing four cephalic papillae. Amphidial apertures large, starting anteriorly within labial plate and continuing on the lateral side of the head as longitudinal, sometimes sinuous slits. Head bears 1-6 fine annules. Cephalic framework weak. Cuticle sometimes thick, folded between annuli, annulation prominent to distinct. Lateral field a protruding band bearing 4,6 or 12 lines (discernable only in SEM), lateral fields with smooth or crenate margin. Spear usually delicate, conus 1/3rd of spear length, basal knobs distinct. Median bulb weakly to moderately developed. Gonad prodelphic, oocytes in single row. Uterus quadricolumellar. Post-vulval uterine sac one or less than one vulval body diameter long. Vagina straight or slightly anteriorly directed. Vulva sunken with epiptygma, vulval slit with small lateral dikes or large lateral flaps. Tail tapering gradually to more or less pointed tip, straight or only terminally curved.

Type species : Malenchus machadoi (Andrassy, 1963) Andrassy 1968

MALENCHUS ACARAYENSIS ANDRASSY, 1968

Measurements

Females (n=10) : L = 0.32-0.36 (0.33±0.01) mm; a = 30-33 (31.5±1.1); b = 5.0-5.5 (5.2±0.18); c = 3.8-4.6 (4.2±0.4); c' = 6.2-7.0 (6.6±0.3); V = 57.0-60.4 (58.6±1.3); stylet = 8.0 um; conus = 3.0 um; oesophagus = 60-65 (62.0±1.7) um; excretory pore = 50-55 (52.5±1.9)

um; v-a = 55-59 (57.2±1.6) um; tail = 71-87 (76.0±6.0) um; tail/v-a = 0.66-0.83 (0.75±0.06).

Males (n=2) : L = 0.34-0.35 mm; a = 35-37; b = 5.5-5.7; c = 3.2-3.5; c' = 14-15; stylet = 8.0 um; conus = 3.0 um; oesophagus = 62-64 um; excretory pore = 46-49 um; spicules = 15.0-16.5 um; gubernaculum = 4.0 um; bursa = 25-28 um; tail = 92-100 um.

Host and locality : Soil around the roots of coffee (Coffea arabica) from Coorg, Karnataka.

Remarks : The measurements and characters of the present specimens closely agree with the original description given by Andrassy (1968).

MALENCHUS UNDULATUS ANDRASSY, 1981

(Fig. 2)

Measurements

Idukki, Kerala population

Females (n=15) : L = 0.38-0.43 (0.40±0.02) mm; a = 24.8-30.8 (28.0±1.5); b = 4.2-5.3 (4.9±0.25); c = 5.2-6.4 (5.5±0.45); c' = 7.6-9.2 (8.1±0.42); V = 62.2-66.2 (64.8±1.3); stylet = 8.2-10.5 (9.2±0.56) um; conus = 4.0 um; oesophagus = 75-89 (81.8±4.4) um; excretory pore = 66-75 (70.0±3.0) um; v-a = 62-69 (64.0±2.5) um; tail = 68.5-79.0 (73.2±2.8) um; tail/v-a = 1.0-1.2 (1.1±0.06).

Males (n=6) : L = 0.36-0.43 (0.40±0.02) mm; a = 27.3-31.7 (29.2±1.5); b = 4.3-5.2 (4.9±0.4); c = 4.6-5.3 (4.8±0.3); c' = 8.8-10.0 (9.2±0.5); stylet = 9.0-10.5 (9.7±0.75) um; conus = 4.0 um; oesophagus = 73-85 (81.0±4.3) um; excretory pore = 63-75 (70.3±4.5) um; spicules = 16-18 (17.4±0.75) um; gubernaculum = 4.0 um; bursa = 30.0-37.5 (34.2±3.0) um; tail = 85-95 (92.2±2.2) um.

Kamrup, Assam population

Females (n=6) : L = 0.38-0.42 (0.40±0.01) mm; a = 25.3-29.7 (28.2±1.6); b = 4.6-5.5 (4.9±0.29); c = 4.4-5.6 (5.2±0.42); c' = 7.7-9.1 (8.2±0.5); V = 59.6-66.2 (64.4±2.7); stylet = 9.5 um; conus = 3.5 um; oesophagus = 70.0-87.6 (82.5±6.4) um; excretory pore = 66-78 (73.4±4.2) um; v-a = 56.0-68.4 (64.3±5.2) um; tail = 74-87 (77.7±4.8) um; tail/v-a = 1.07-1.28 (1.10±0.07).

Males (n=1) : L = 0.40 mm; a = 32.6; b = 4.5; c = 4.5; c' = 9.4; stylet = 9.5 um; conus = 3.5 um; oesophagus = 89.0 um; excretory pore = 74.0 um; spicules = 18.0 um; gubernaculum = 4.0 um; bursa = 37.0 um; tail = 89.0 um.

Description

Female : Body small, arcuate upon fixation, tapering gradually anterior to base of oesophagus and posterior to vulva. Cuticle deeply annulated, annules 1.0-1.5 um wide at midbody. Lateral fields crenate, 1/8th - 1/9th of body width wide, originating at spear base,

terminating near middle of tail. Lip region narrow, 3 um high, 4.5 um wide at base with 4-5 fine annules. Cephalic framework inconspicuous. Amphidial apertures distinct, longitudinal slit-like. Stylet slender, conus needle - like; basal knobs round to oval-shaped, 3 um wide. Dorsal oesophageal gland opening 2-3 um behind spear base. Oesophagus with 16.5-25.5 um long procorpus. Metacorpus oval, relatively well developed with valve plates, 9.0-10.5 um long at the middle of oesophagus. Isthmus narrow, 22-28 um long. Basal oesophageal part an elongate, distinct bulb, 15-24 um long. Cardia tongue-shaped, 3.0-4.5 um long. Nerve ring 52-58 um from anterior end. Excretory pore at beginning of basal bulb. Hemizonid two annules wide, anteriorly adjacent to excretory pore.

Reproductive system monoprodelphic. Oocytes arranged in single row. Vulva sunken, lateral dikes 2-3 annules long, vagina anteriorly directed. Uterus with muscular and glandular parts. Spermatheca oval, 18 um long. Post-uterine sac 7.5 um or half vulval body width long. Tail 7.6-9.2 anal body widths or slightly more than vulva-anus distance long. Tail curved terminally, tip pointed.

Male : Similar to females. Spicules simple, arcuate. Gubernaculum curved. Bursa smooth. Tail terminus pointed.

Host and localities : Soil around the roots of (i) pepper (Piper nigrum) from Idukki, Kerala, (ii) tea (Camellia sinensis) from Kamrup, Assam.

Remarks : The present specimens closely conform with the measurements and description of Malenchus undulatus given by Andrassy (1981) except that the lateral fields originate at the base of spear and the tail is slightly longer than v-a distance (lateral field originating at 1/2 to 2/3rd spear length and tail equal to v-a distance in original description). This is the first report of the species from India.

SUBFAMILY **TYLODORINAE** PARAMONOV, 1967

Diagnosis : (Modified after Geraert & Raski, 1987). Body small to moderate size. Head continuous or offset, with an oral disc, amphidial apertures longitudinal slits, located in a lobed or slightly divided labial disc. Stylet long to very long. Female gonad with long posterior uterine sac. Crustaformeria with five to six cells in each of the four rows. Spermatheca non-offset, elongated. Tail elongated with terminus acute to finely rounded.

Type genus : Tylodorus Meagher, 1963

Other genera: Campbellenchus Wouts, 1977
Cephalenchus Goodey, 1962
Eutylenchus Cobb, 1913
Macrotrophurus Loof, 1958

CEPHALENCHUS GOODEY, 1962

Diagnosis : Small to medium-sized species. Body with coarse annuli; cephalic region as high as wide, may or may not be setoff by basal constriction. Stylet slender (14-25 um), cone about one-half stylet length, knobs well developed, rounded, sometimes anteriorly concave. Labial plate deeply and broadly indented dorsally and ventrally bearing four button-like papillae, one each on submedian sectors of labial plate; amphidial apertures squarish/ovoid pits or elongate lateral slits extending from distinct oral disc to edge of labial basal plate. Lateral fields mostly with six longitudinal incisures,

equally spaced, deeply indented, four lines also present. Basal glandular region of oesophagus small, pyriform or elongated; enclosed in symmetrical bulb or slightly overlapping intestine. Tail long, very slender, terminus effiliate, acute or finely rounded; shorter, conoid, more bluntly rounded also present.

Type species : Cephalenchus hexalineatus (Geraert, 1962) Geraert & Goodey, 1964.

CEPHALENCHUS CEPHALODISCUS SULTAN & JAIRAJPURI, 1981

Measurements

Females (n=15) : L = 0.66-0.75 (0.70±0.03) mm; a = 45.3-52.8 (49.5±2.5); b = 6.8-7.8 (7.3±0.3); c = 2.7-3.5 (3.2±0.26); c' = 22.3-30.0 (24.5±2.7); V = 52.4-61.5 (57.6±2.9); stylet = 18-21 (19.5±1.2) um; conus = 9.0-10.5 (9.5±0.72) um; oesophagus = 94.5-102.0 (97.0±3.2) um; excretory pore = 72-80 (75.5±2.9) um; v-a = 67-78 (73.3±3.7) um; tail = 200-270 (225.0±27.9) um; tail/v-a = 2.66-3.43 (3.08±0.33).

Males (n=5) : L = 0.61-0.63 (0.62±0.06) mm; a = 46.6-51.1 (49.2±1.7); b = 6.6-7.0 (6.8±0.14); c = 3.0-3.3 (3.2±0.1); c' = 18.6-19.7 (19.0±0.66); stylet = 18.0 um; conus = 9.5 um; oesophagus = 90-93 (91.2±1.3) um; excretory pore = 72.0-76.5 (74.3±1.7) um; spicules = 16.5 um; gubernaculum = 7.5 um; bursa = 15-18 (16.2±1.3) um; tail = 195-220 (208.0±10.3) um.

Host and locality : Soil around the roots of lady's finger (Abelmoschus esculentum) from Kaziranga, Assam.

Remarks : The present specimens closely agree with the description and measurements of Cephalenchus cephalodiscus given by Sultan & Jairajpuri (1981). However, these specimens are slightly longer, having a higher tail/v-a ratio and a slightly sublateral vulva.

CEPHALENCHUS LEPTUS SIDDIQI, 1963

Measurements

Chikmagalur, Karnataka population

Females (n=10) : L = 0.61-0.64 (0.63±0.02) mm; a = 41.5-45.2 (44.2±0.9); b = 7.7-8.2 (8.1±0.08); c = 3.0-3.3 (3.2±0.03): c' = 18.0-20.6 (19.2±0.9); V = 57.5-59.1 (58.8±0.13); stylet = 16.5 um; conus = 8.0 um; oesophagus = 78.0-88.5 (83.8±3.2) um; excretory pore = 55-61 (58.5±2.1) um; v-a = 63-72 (67.0±5.1) um; tail = 190-216 (200.0±8.9) um; tail/v-a = 2.8-3.2 (2.9±0.2).

Males (n=6) : L = 0.59-0.65 (0.62±0.02) mm; a = 41-45 (43.0±1.3); b = 7.8-10.3 (8.5±0.85); c = 3.2-3.4 (3.3±0.09); c' = 16.8-18.8 (17.5±0.75); stylet = 15.0-16.5 (15.8±0.74) um; conus = 8.0 um; oesophagus = 67.5-84.0 (79.5±5.5) um; excretory pore = 52.5-60.0 (56.3±2.7) um; spicules = 18-21 (19.2±1.5) um; gubernaculum = 7.5 um; bursa 33-39 (36.5±2.0) um; tail = 182-205 (195.0±8.0) um.

Tezpur, Assam population

Females (n=10) : L = 0.56-0.65 (0.62±0.03) mm; a = 39.6-43.8 (42.8±2.5); b = 5.8-6.8 (6.4±0.4); c = 2.9-3.6 (3.2±0.12); c' = 18.5-25.2 (22.0±1.7); V = 51.6-59.7 (56.8±2.4); stylet = 18.0 um; conus = 9.0 um; oesophagus = 94.5-99.0 (97.0±1.6) um; excretory pore = 57.0-67.5 (61.6±3.0) um; v-a = 58.5-72.0 (68.0±4.2) um; tail = 185-210 (203.0±8.0) um; tail/v-a = 2.33-3.17 (2.86±0.24).

Males : Not found.

Host and localities : Soil around the roots of (i) silver oak (Quercus alba) from Chikmagalur, Karnataka, (ii) bamboo (Bambusa sp.) from Tezpur, Assam.

Remarks : This species is widely distributed in India. The present specimens closely agree with the previous descriptions of Cephalenchus leptus given by Siddiqi (1963b) and Andrassy (1984) except in having smaller oesophagus (oesophagus = 98-106 um long in Andrassy's description).

SUBFAMILY ATYLENCHINAE SKARBILOVICH, 1959

Diagnosis (Modified after Geraert & Raski, 1987). Lip region with one large, laterally elongated plate; amphidial apertures large, round. Lateral fields with two to six lines, longitudinal ridges may be present. Stylet medium sized, conus about 50% of stylet length. Vulva covered by lateral or longitudinal flaps. Males usually with large hypoptygma.

Type genus : Atylenchus Cobb, 1913

Other genera : Aglenchus Andrassy, 1954
Antarctenchus Spaull, 1972
Coslenchus Siddiqi, 1978
Pleurotylenchus Szczygiel, 1969
Gracilancea Siddiqi, 1976

AGLENCHUS ANDRASSY, 1954

Diagnosis : Body small (0.35-0.77 mm), straight to slightly arcuate. Cuticle coarsely annulated. Lateral fields each with 2 prominently raised ridges (with 3 or 4 incisures); no other longitudinal ridges besides those in lateral fields. Cephalic region without distinct striations. Amphids indistinct, pore-like. Stylet less than 15 um long, conus about half of stylet length, knobs rounded. Median bulb round to oval, muscular, with conspicuous refractive thickenings; basal bulb elongate, pyriform. Cardia discoidal. Deirids near excretory pore. Phasmids dorso-sublateral, post-median, in females slightly anterior to vulva. Vulva sunken with larger outer and

smaller inner lips and conspicuous lateral membranes, at 53-65% of body length. Vagina directed forward, walls often swollen. Post vulval uterine sac absent. Spermatheca offset, round to oval, usually with sperms. Tail elongate-filiform, longer than vulva-anus distance. Males usually present, with an adanal bursa, 11-16 um long spicules and elevated-pointed cloacal lips.

Types species : Aglenchus agricola (De Man, 1884) Meyl, 1961

AGLENCHUS MUKTII PHUKAN & SANWAL, 1980

Measurements

Lumbding, Assam population

Fmelaes (n=10) : L = 0.48-0.57 (0.51±0.03) mm; a = 36-39 (37.6±1.0); b = 6.4-7.5 (6.9±0.32); c = 2.6-2.9 (2.8±0.11); c' = 18.5-22.2 (20.6±1.2); V = 49.5-56.0 (51.6±2.0); stylet = 12.0-13.5 (12.6±0.76) um; conus = 6.0 um; oesophagus = 70.5-78.0 (74.5±2.5) um; excretory pore = 64-68 (65.6±1.4) um; v-a = 62-85 (72.0±7.0) um; tail = 163-200 (183.0±12.5) um; tail/v-a = 2.3-3.2 (2.5±0.3).

Shillong, Meghalaya population

Females (n=8) : L = 0.48-0.58 (0.54±0.04) mm; a = 32.5-38.7 (36.3±2.0); b = 6.5-7.2 (6.7±0.23); c = 2.8-3.4 (3.0±0.2); c' = 17.4-21.4 (20.0±1.6); V = 50.7-52.6 (52.0±0.72); stylet = 12.0 um; conus = 6.0 um; oesophagus = 79.5-85.5 (82.5±1.7) um; excretory pore = 66.0-70.5 (67.5±1.9) um; v-a = 69-87 (78.8±7.3) um; tail = 162-195

(185.0±11.0) um; tail/v-a = 2.2-2.6 (2.3±0.12).

Males (n=8) : L = 0.52-0.59 (0.55±0.02) mm; a = 37.5-40.2 (39.3±1.0); b = 6.4-7.0 (6.7±0.24); c = 2.7-3.2 (2.8±0.14); c' = 19.8-23.5 (21.4±1.3); stylet = 12.0 um; conus = 6.0 um; oesophagus = 78.0-85.5 (82.2±2.6) um; excretory pore = 64.5-72.0 (70.0±2.6) um; spicules = 15.0-16.5 (15.8±0.75) um; gubernaculum = 4.5-6.0 (5.5±0.7) um; bursa = 34.5-39.0 (37.0±1.8) um; tail = 178-212 (192.0±12.0) um.

Host and localities : Soil around the roots of (i) forest tree (unidentified) from Lumbding, Assam, (ii) jack fruit (Artocarpus altilis) from Shillong, Meghalaya.

Remarks : The present specimens closely conform to the measurements and description of Aglenchus muktii as given by Phukan & Sanwal (1980a) and Geraert & Raski (1988).

COSLENCHUS SIDDIQI, 1978

Diagnosis : Body small (0.33-0.65 mm), straight to arcuate when relaxed. Body cuticle coarsely annulated and modified into longitudinal ridges, 10-22 in number, excluding those of lateral fields at midbody. Lateral fields with 2 to 3 ridges being more elevated than other body ridges. Cuticle surface outside lateral fields showing minute squares or rectangles formed by transverse and longitudinal striae or grooves. Cephalic region continuous or only slightly offset, striated. Stylet under 15 um long with conus less than half its length. Median oesophageal bulb pyriform or more elongate; cardia rounded to discoidal. Vulva with lateral membranes which may be rudimentary. Vagina at right angle to body axis or slightly directed forward, with walls appearing swollen. Ovary single, outstretched. Spermatheca usually without sperms. Post-vulval uterine sac present, rarely absent. Phasmids dorso-sublateral, post-median, in females usually just behind level of vulva. Deirids at the level of excretory pore or just posterior to it. Tail straight, elongate-conoid to filiform. Male usually rare, with adanal bursa and cloacal lips forming a short tube.

Type species : Coslenchus costatus (De Man, 1921) Siddiqi, 1978

COSLENCHUS AREOLATUS (EGUNJOBI, 1967) SIDDIQI, 1978

Measurements

Females (n=6) : L = 0.41-0.46 (0.44±0.02) mm; a = 31.2-34.2 (32.6±1.2); b = 5.4-5.7 (5.5±0.13); c = 4.7-5.3 (4.8±0.12); c' =

9.2-11.0 (9.8±0.82); V = 62.2-64.6 (63.4±0.95); stylet = 12.0 um; conus = 4.5 um; oesophagus = 75.0-82.5 (79.0±2.9) um; excretory pore = 65-73 (62.2±3.0) um; v-a = 66-75 (69.0±3.7) um; tail = 82.5-99.0 (88.2±6.5) um; tail/v-a = 1.25-1.37 (1.3±0.02).

Males : Not found.

Host and locality : Soil around the roots of rubber (Ficus elastica) from Kottayam, Kerala.

Remarks : The present specimens closely conform with the descriptions given by Egunjobi (1967) and Andrassy (1981).

COSLENCHUS COCOPHILUS ANDRASSY, 1981

Measurements

Females (n=12) : L = 0.39-0.43 (0.41±0.01) mm; a = 30-35 (33.0±1.5); b = 5.2-5.8 (5.4±0.22); c = 5.2-5.5 (5.3±0.14); c' = 7.8-8.6 (8.2±0.3); V = 65.3-68.0 (66.3±0.86); stylet = 11.0 um; conus = 4.5 um; oesophagus = 73.5-79.0 (76.0±1.7) um; excretory pore = 60.0-64.5 (63.0±1.7) um; v-a = 59-72 (63.0±4.0) um; tail = 75-82 (77.0±2.7) um; tail/v-a = 1.08-1.30 (1.23±0.07); Rvan = 36-38..

Males : Not found.

Host and locality : Soil around the roots of orange fruit tree (Citrus sinensis) from Gadwal, Andhra Pradesh.

Remarks : The present specimens conform to the description of Coslenchus cocophilus Andrassy, 1981. However, minor variations occur in body length, position of vulva, tail length and annules between vulva and anus (L = 460-500 um; V = 64-65, tail = 97-102 um and Rvan 29-30 in Andrassy's description). These differences are considered as intraspecific variations.

SUBFAMILY **BOLEODORINAE** KHAN, 1964

Diagnosis : (Modified after Brzeski & Sauer, 1983). Small to medium size nematodes. Oral opening surrounded by six papillae, a second circle of four papillae on the edges of anterior surface. Amphidial openings open V-shape or oblique slits, post-labial in position, covered by a flap. Stylet delicate, conus about half of stylet length, knobs small, may be flange-like, sometimes absent. Median bulb with or without valve plates. Reproductive system monodelphic or didelphic; prodelphic or amphidelphic. Uterus and spermatheca usually with few cells, spermatheca offset or non-offset. Bursa small, adanal. Tail elongated; tip rounded, spicate or clavate.

Type genus : Boleodorus Thorne, 1941

Other genera : Basiria Siddiqi, 1959
Basirienchus Geraert & Raski, 1986
Duotylenchus Saha & Khan, 1982
Neopsilenchus Thorne & Malek, 1968
Neothada Khan, 1973
Psilenchus De Man, 1921
Atetylenchus Khan, 1973

PSILENCHUS DE MAN, 1921

Diagnosis : Body 0.7-1.7 mm long, usually curved upon fixation. Lateral fields each with four incisures, inner two may be indistinct or absent. Amphidial apertures transverse, slit-like, at base of lateral lip areas. Phasmids distinct, on tail, anterior to its middle.

Cephalic region elevated, rounded or conoid, smooth or striated; framework lightly sclerotized with conspicuous outer margins extending into body. Stylet cylindrical, 10-24 um long. Conus distinctly shorter than shaft, basal knobs absent. Median bulb prominent, generally oval, usually behind middle of oesophagus. Basal bulb small, pyriform; cardia discoidal or rounded. Vulva near middle of the body (V = 45-53), lacking epiptygma and lateral membranes. Ovaries paired, outstretched in opposite directions. Spermatheca elongate, axial. Tail elongate, with clavate or non-clavate, rounded tip. Bursa prominent, adanal. Sperms round, moderately large. Spicules tylenchoid, 25-33 um long. Gubernaculum simple, trough-shaped.

Type species : Psilenchus hilarulus De Man, 1921

PSILENCHUS FASCICULII n.sp.

(Fig. 3)

Measurements

Paratype females (n=8) : L = 0.83-1.04 (0.91±0.07) mm; a = 47.7-55.3 (50.7±2.4); b = 6.5-7.7 (7.0±0.42); c = 6.0-6.9 (6.5±0.34); c' = 10.2-12.0 (11.3±0.5); V = 46-48 (47.0±0.75); stylet = 12.0-13.5 (12.4±0.64) um; conus = 4.0-4.5 (4.2±0.24) um; oesophagus = 120-144 (128.0±5.3) um; excretory pore = 90-108 (100.0±7.5) um; v-a = 308-390 (348.0±31.5) um; tail = 125-150 (138.8±6.8) um; tail/v-a = 0.37-0.42 (0.39±0.01).

Holotype female : L = 0.97 mm; a = 50; b = 7.5; c = 6.9; c' = 11.8; V = 47.2; stylet = 13.5 um; conus = 4.5 um; oesophagus = 130 um; excretory pore = 106 um; v-a = 375 um; tail = 142 um; tail/v-a = 0.37.

Paratype males (n=6) : L = 0.81-0.87 (0.84±0.02) mm; a = 49.5-60.0 (51.3±1.3); b = 6.0-6.9 (6.7±0.4); c = 5.0-5.7 (5.4±0.3); c' = 10.0-12.5 (11.0±0.99); stylet = 12.0-13.5 (12.5±0.7) um; conus = 4.0-4.5 (4.2±0.35) um; oesophagus = 120-140 (127.3±7.7) um; excretory pore = 92-113 (102.0±7.8) um; spicules = 27-30 (28.2±1.3) um; gubernaculum = 10.5-12.0 (10.8±0.64) um; bursa = 45-54 (50.2±3.3) um; tail = 150-170 (158.0±7.0) um.

Description

Female : Body slender, slightly to strongly curved upon relaxation, tapering anteriorly from base of oesophagus, posteriorly terminating as a filiform tail with clavate terminus. Cuticle finely striated, each striae less than 1.0 um apart at midbody and 2.0-2.5 um apart on post-anal region. Lateral fields with three ridges 25-30% body width wide at midbody, originating near spear base and terminating on posterior third of tail end, outer lines crenate. The two outer ridges narrower than middle one. Anterior end and tail with completely areolated outer ridges. Lip region round, continuous, smooth, 6.0-7.5 um wide and 4.5 um high. Amphidial apertures post-labial, oblique slits. Cephalic framework weakly sclerotized. Stylet slender, conus one-third of spear length and attenuated, basal

knobs absent. Orifice of dorsal oesophageal gland about 1.5-3.0 um behind spear base. Procorpus 56-65 um long, gradually enlarging to a oval, muscular metacorpus. Metacorpus 15-18 um long and 10.5 um wide with 4.5 um long sclerotized valve plates located at 54-58% of oesophageal length. Isthmus slender, 27-34 um long. Basal bulb ovate, 18-23 um long, 10.5 um wide. Cardia distinct, 3.0-4.5 um long, broadly rounded. Nerve ring 90-105 um from anterior end. Excretory pore near the middle of isthmus. Hemizonid anterior to excretory pore. Deirids at the level of excretory pore. Intestine with fasciculi like structures.

Gonads amphidelphic. Oocytes arranged in single row at tip and in two rows posteriorly, sometimes in single row. Vulval opening a transverse slit. Vagina muscular, 8-9 um or 45-50% of vulval body width deep. Uterus with proximal glandular and distal muscular parts. Spermatheca oblong, 20-30 um long. Rectum less than anal body width long, post-rectal sac 12-18 um long, extending behind the anus. Tail elongate, filiform, 10-12 anal body widths long, tapering gradually to a clavate terminus. Phasmids 2.0-2.5 anal body widths from anus.

Male : Similar to female except for a slightly smaller body. Spicules well developed, ventrally curved, capitulum oval - shaped. Gubernaculum trough - shaped. Bursa finely crenate, adanal. Tail similar to that of female.

Type **habitat and locality** : Soil around the roots of turmeric (Curcuma longa) from Kurnool, Andhra Pradesh.

Type material

Holotype : Female on slide Psilenchus fasciculii n.sp./1; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Paratypes : Females and males on slide Psilenchus fasciculii n.sp./2-12; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Diagnosis and relationship :

Psilenchus fasciculii n.sp.is characterized by a continuous, smooth lip region; a 12.0-13.5 um long stylet; dorsal oesophageal gland opening near the base of spear; lateral fields with four lines 1/3rd body width wide; presence of post-rectal sac and intestinal fasciculi; oblong spermatheca and coarsely striated filiform tail with clavate terminus.

The new species comes close to P. minor Siddiqi, 1963; P. aestuarius Andrassy, 1962; P. neoformis Jairajpuri & Siddiqi, 1963; P. hilarulus De Man, 1921 and P. kumaoensis n.sp. in having smooth lip region and four lateral lines. However, it differs from all these species in having intestinal fasciculi. It further differs from P. aestuarius and P. neoformis in having a longer filiform tail with

coarse annules and presence of post-rectal sac (c = 8.0-10.7, post-rectal sac absent, tail without coarse striations in P. aestuarius and P. neoformis). From P. minor it further differs in having dorsal oesophageal gland opening near spear base, crenate outer line of lateral fields, presence of post-rectal sac and smaller gubernaculum (dorsal oesophageal gland opening 7 um behind spear base, lateral lines smooth, post-rectal sac absent and gubernaculum 6 um long in P. minor). From P. hilarulus it differs in having post-rectal sac (post-rectal sac absent in P. hilarulus). It can be differentiated from P. kumaoensis n.sp. in having narrower lateral fields, position of dorsal oesophageal gland opening, a longer filiform tail (lateral fields half of body width, dorsal oesophageal gland opening about half spear length behind spear base, tail long conoid, 7-9 anal body widths long in P. kumaoensis n.sp.).

PSILENCHUS KUMAOENSIS n.sp.

(Fig. 4)

Measurements

Paratype females (n=10) : L = 1.05-1.23 (1.13±0.04) mm; a = 46.4-52.3 (48.4±1.86); b = 6.9-8.2 (7.5±0.4); c = 7.0-8.9 (7.6±0.56); c' = 7.1-8.6 (8.2±0.5); V = 47.3-49.6 (48.3±0.86); stylet = 13.5-15.0 (14.2±0.74) um; conus = 4.5-5.0 (4.7±0.25) um; oesophagus = 144-160 (151.0±5.0) um; excretory pore = 112-123 (117.0±3.5) um; v-a = 423-480 (450.0±22.0) um; tail = 128-165 (148.0±10.0) um; tail/v-a = 0.27-0.36 (0.33±0.03).

Holotype female : L = 1.13 mm; a = 47.0; b = 7.0; c = 7.3; c' = 8.5; V = 49.0; stylet = 13.5 um; conus = 4.5 um; oesophagus = 160.0 um; excretory pore = 123.0 um; v-a = 423.0 um; tail = 153.0 um; tail/v-a = 0.36.

Paratype males (n=2) : L = 1.00-1.02 mm; a = 44.0-45.3; b = 6.75-6.77; c = 6.2-6.9; c' = 8.2-9.0; stylet = 12.0 um; conus = 4.0 um; oesophagus = 148-151 um; excretory pore = 106-114 um; spicules = 28.5-31.0 um; gubernaculum = 12.0 um; bursa = 45-56 um; tail = 148-162 um.

Description

Female : Body long, slender, straight to C-shaped upon relaxation, tapering anterior to oesophagus, posteriorly terminating as a elongate tail with clavate terminus. Cuticle finely striated, each striae less than 1.0 um apart at midbody, but 1.5 um apart at anterior and posterior ends. Lateral fields with three ridges forming four lines, occupying about 50% of body width at midbody, originating behind spear base and terminating at middle of tail, outer ridges crenate, wider than inner ones; inner lines very faint. Lip region blunt with rounded corners, continuous with body, smooth, 8-9 um wide and 4.5 um high. Amphidial apertures post-labial, oblique slit-like. Cephalic framework inconspicuous. Stylet slender, 13.5-15.0 um long, conus 30-33% of stylet length, attenuated. Knobs absent. Orifice of dorsal oesophageal gland 7-8 um behind spear base. Procorpus slender,

68-77 um long. Median bulb oval, muscular, 19-21 um long, 10.5 um wide with 9 um long valvular plates. Isthmus slender, 28.5-33.0 um long. Basal oesophageal bulb pyriform, 21-28 um long, 10.5 um wide. Cardia tongue-shaped, 4.5 um long. Nerve ring 108-118 um from anterior end. Excretory pore near the base of isthmus, excretory duct sclerotized. Hemizonid anteriorly adjacent to excretory pore. Deirids at the level of excretory pore.

Gonads amphidelphic, outstretched. Oocytes arranged in double row at tip and posteriorly in single row. Vulval opening a transverse slit; vagina muscular, 10-12 um deep. Uterus with proximal glandular and distal muscular parts. Spermatheca oblong, 28-36 um long. Rectum 0.5 anal body widths long, a small post-rectal sac present. Tail elongate, regularly tapering to a slightly clavate terminus. Phasmids two anal body widths behind anus.

Male : Similar to females except in having smaller body. Spicules strong, ventrally arcuate; capitulum squarish, with a larger dorsal arm. Gubernaculum trough-shaped. Bursa adanal with crenate margin. Tail similar to female.

Type habitat and locality : Soil around the roots of forest tree (unidentified) from Almora, Uttar Pradesh.

Type material

Holotype : Female on slide Psilenchus kumaoensis n.sp./1; deposited in the nematode collection of Department of Zoology, Aligarh Muslim

University, Aligarh.

Paratypes : Females and males on slides Psilenchus kumaoensis n.sp./2-12; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Diagnosis and relationship :

Psilenchus kumaoensis n.sp. is characterized by a smooth, continuous lip region, 13.5-15.0 um long, dorsal oesophageal gland opening about half spear length behind spear base, lateral fields about 50% of body width wide, presence of post-rectal sac, a non-offset oblong spermatheca, tail elongate, regularly tapering with clavate terminus and phasmids two anal body widths behind anus.

The new species comes close to P. minor Siddiqi, 1963 and P. neoformis Jairajpuri & Siddiqi, 1963 in having smooth lip region, dorsal oesophageal gland opening ½ spear length behind spear base and four lateral lines. It differs from both the species in having wider lateral fields, in the shape of spicules and presence of post-rectal sac. It further differs from P. minor in having a longer body; greater 'b' and 'c' values, smaller c' value and longer gubernaculum (L = 0.85-0.89 mm; b = 5.6-6.4; c = 5.8-6.3; c' = 11.0; gubernaculum = 6.0 um long in P. minor). From P. neoformis it further differs in having wider annules on tail than on body, oblong spermatheca and length of bursa (striations on body and tail similar, spermatheca spherical and bursa 72 um long in P. neoformis).

BOLEODORUS THORNE, 1941

Diagnosis : Body under 1 mm (0.33-0.72 mm). Cuticle finely annulated. Lateral fields with four incisures, not areolated. Cephalic region elevated, conoid-rounded, smooth, with or without a depression at oral aperture. Cephalic framework weakly to moderately sclerotized. Amphidial apertures oval or crescentic slits, obliquely placed on the head. Stylet generally 8-10 um long; conus about one third of total stylet length; knobs flanged, rarely rounded. Orifice of dorsal oesophageal gland 1-4 um from stylet base. Median bulb fusiform swelling without valve plates, located anterior to middle of oesophagus. Basal bulb pyriform. Excretory pore behind nerve ring; terminal excretory duct generally sclerotized. Vulva generally at 59-75% of body length. Post-vulval uterine sac short, less than a body width long. Spermatheca offset, oval or elongate; ovary short, with oocytes in one or multiple rows. Tail ventrally arcuate or straight and usually terminally hooked. Bursa adanal.

Type species : Boleodorus thylactus Thorne, 1941

BOLEODORUS CARICAI n.sp.

(Fig. 5)

Measurements

Paratype females (n=8) : L =0.48-0.50 (0.49±0.06) mm; a = 32.3-33.3 (32.6±0.41); b = 4.7-5.5 (5.2±0.34); c = 6.8-7.3 (7.1±0.2); c' = 6.3-6.7 (6.5±0.2); V = 64.2-65.3 (64.7±0.5); stylet = 12.0 um; conus

= 5.0 um; oesophagus = 90-102 (95.3±5.4) um; excretory pore = 73-85 (80.4±4.2) um; v-a = 96.0-106.5 (102.0±3.9) um; tail = 66.0-70.5 (69.0±1.9) um; tail/v-a = 0.64-0.73 (0.67±0.03).

Holotype female : L = 0.49 mm; a = 32.7; b = 5.4; c = 7.0; c' = 6.7; V = 64.3; stylet = 12.0 um; conus = 5.0 um; oesophagus = 90.0 um; excretory pore = 85.0 um; v-a = 103.5 um; tail = 70.5 um; tail/v-a = 0.68.

Paratype male (n=1) : L = 0.48 mm; a = 37.5; b = 4.3; c = 7.0; c' = 7.2; stylet = 12.0 um; conus = 5.0 um; oesophagus = 105.0 um; excretory pore = 81.0 um; spicules = 15.0 um; gubernaculum = 4.5 um; bursa = 24.0 um; tail = 64.5 um.

Description

Female : Body small, slightly curved to closed C-shaped upon fixation, tapering regularly to a narrow head anteriorly and a conoid, hooked tail posteriorly. Cuticle finely striated, each striae less than 1.0 um wide apart at midbody. Lateral fields with four lines, outer lines crenate, one third of body width wide at midbody, originating near spear base and terminating on posterior third of tail. Lip region not setoff, conoid, with a small depression, 6-7 um wide, 4.5 um high. Amphidial apertures prominent oblique slits, post-labial in position. Cephalic framework inconspicuous. Stylet slender, shaft with faint lumen; conus needle-like, less than half of stylet length. Basal part of stylet with thick flanges, 3 um wide. Dorsal oesophageal gland opening 3 um behind spear base.

Procorpus 35.0-42.5 um long. Metacorpus not distinctly separate from procorpus, nonmuscular, nonvalvate, located posterior to middle of oesophagus. Isthmus narrow, 15-21 um long. Basal bulb oval with more or less flat base, 18.0-22.5 um long, 10.5 um wide. Cardia hemispherical, 3.0 um long. Nerve ring 62-68 um from anterior end. Excretory pore near base of isthmus. Hemizonid anteriorly adjacent to excretory pore.

Gonad monoprodelphic. Oocytes arranged in single row, vulva a transverse slit. Vagina muscular, half of vulval body width deep. Uterus with proximal glandular and distal muscular parts. Spermatheca oval, 18-24 um long. Post-uterine sac 12-15 um long. Distance between vulva and anus 1.36-1.54 times tail length. Tail long, conoid, hooked, terminus round. Phasmids not distinct.

Male : Similar to female except for a smaller body. Spicules ventrally arcuate, capitulum oval shaped. Gubernaculum simple, curved. Bursa adanal, crenate. Tail long conoid, hooked, with rounded terminus.

Type habitat and locality : Soil around the roots of papaya (Carica papaya) from Haldwani, Uttar Pradesh.

Type material

Holotype : Female on slide Boleodorus caricai n.sp./1; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Paratypes: Females and male on slide Boleodorus caricai n.sp./2-9; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Diagnosis and relationship :

Boleodorus caricai n.sp. is characterized by a continuous head without involution, lateral fields with outer margins crenate, median bulb slightly posteriorly located, hemizonid adjacent to excretory pore and a hooked tail.

The new species comes close to B. thylactus Thorne, 1941; B. similis Khan & Basir, 1964; B. hyderi Husain & Khan 1965 and B. constrictus n.sp. in having hooked tail. However, it differs from B. thylactus in the absence of head involution, greater 'a' value, anteriorly located vulva, longer tail and post-uterine sac greater than half of the vulval body width (head with involution, a = 21-28; V = 69; c = 10 and post-uterine sac rudimentary in B. thylactus). It differs from B. similis in having a longer body, greater 'a' and 'b' values and crenate outer lines of lateral fields (L = 380-440 um; a = 19-24; b = 3.0-4.7 and outer lateral lines smooth in B. similis). From B. hyderi it differs in having a conoid, continuous head with depression at anterior end, median bulb posteriorly located, base of oesophageal bulb flat, slightly longer stylet, lateral fields with crenate outer lines (head without depression at anterior end, median bulb anteriorly located, basal bulb offset from intestine, stylet 10 um long, outer lateral lines smooth in B. hyderi). It also differs

from B. constrictus n.sp. in body shape , position of hemizonid, arrangement of oocytes, in having well developed spermatheca and presence of males (body closed C-shaped to spiral, hemizonid three to four annules anterior to excretory pore, oocytes arranged in double row at tip of the ovary, reduced spermatheca and males absent in B. constrictus n.sp.).

BOLEODORUS CONSTRICTUS n.sp.

(Fig. 6)

Measurements

Paratype females (n=8) : L =0.49-0.55 (0.52±0.02) mm; a = 31.8-37.0 (34.7±1.9); b = 4.6-5.4 (5.0±0.27); c = 6.4-8.0 (6.9±0.53); c' = 6.4-9.0 (7.8±0.85); V = 63.3-67.2 (64.8±1.4); stylet = 11.0 um; conus = 5.0 um; oesophagus = 93-107 (102.0±4.9) um; excretory pore = 78-86 (80.5±2.2) um; v-a = 91-133 (107.0±13.7) um; tail = 68-85 (75.7±5.8) um; tail/v-a = 0.71-0.79 (0.75±0.03).

Holotype female : L = 0.52 mm; a = 31.8; b = 4.9; c = 6.6; c' = 8.3; V = 65.7; stylet = 11.0 um; conus = 5.0 um; oesophagus = 107.0 um; excretory pore = 80.0 um; v-a = 100.0 um; tail = 79.0 um; tail/v-a = 0.79.

Description

Female : Body small, closed C-shaped to spiral upon fixation, narrow at head end, distinctly tapering posterior to vulva and anus, terminating as an elongate-conoid tail with hooked terminus. Cuticle

finely striated, each striae less than 1.0 um apart at midbody. Lateral fields with four lines, outer lines crenate, inner lines very faint, one third of body width wide at midbody, originating near spear base and terminating at posterior third of tail. Lip region continuous, conical, anterior end with slight depression, smooth, 5-6 um wide and 4.5 um high. Amphidial apertures prominent oblique slits, post-labial in position. Cephalic framework weak. Stylet slender, weak; conus needle-like; knobs flang-like, 2.5 um wide. Dorsal oesophageal gland opening 2.5 um behind spear base. Procorpus 28-35 um long, enlarging slightly to a metacorpus. Metacorpus not distinctly separate from procorpus, nonvalvate, nonmuscular, 6 um wide. Isthmus narrow, tubular, 16.5-21.0 um long. Basal bulb ovate, 22-27 um long, 9.5 um wide. Cardia hemispherical, 4 um long. Nerve ring 58-66 um from anterior end. Excretory pore near the base of isthmus. Hemizonid three to four annules anterior to excretory pore.

Gonad monoprodelphic. Oocytes arranged in double row at tip and single row posteriorly. Vulva a transverse slit. Vagina muscular, half of vulval body width deep. Uterus with proximal glandular and distal muscular parts. Spermatheca oval, 12-18 um long, reduced and nonfunctional. Post-uterine sac 10.0-13.5 um or half to three-fourths vulval body width long. Distance between vulva and anus 1.26-1.95 times tail length. Body posterior to anus distinctly narrower than preanal region. Tail elongate-conoid, arcuate, with hooked terminus, tip rounded. Phasmids not distinct.

Male : Not found.

Type habitat and locality : Soil around roots of papaya (Carica papaya) from Almora, Uttar Pradesh.

Type material

Holotype : Female on slide Boleodorus constrictus n.sp./1; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Paratypes : Females on slides Boleodorus constrictus n.sp./2-8; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Diagnosis and relationship

Boleodorus constrictus n.sp. is characterized by a distinct narrowing of body beyond vulva and anus, lateral fields with outer margins crenate, a conoid lip region with a depression at anterior end, metacorpus not distinctly demarcated from procorpus, reduced spermatheca and a hooked tail.

The new species comes close to B. thylactus Thorne, 1941; B. similis Khan & Basir, 1964; B. hyderi Husain & Khan, 1965 and B. caricai n.sp. in having hooked tail. It can be differentiated from all the four species by the distinct narrowing of body posterior to vulva and anus. It further differs from B. thylactus in having a more slender body, longer tail, anteriorly located vulva and

absence of involution on head (a = 21-28; c = 9.2-10.0; V = 69.0 and head with involution in B. thylactus). From B. similis it differs in having longer body, greater 'a' value and in the absence of males (L = 390-440 um; a = 19-24 and males present in B. similis). It can be differentiated from B. hyderi in having higher 'a' value, nature of lateral fields and position of hemizonid (a = 23-27; lateral fields smooth, four lines very distinct, hemizonid adjacent to excretory pore in B. hyderi). It also differs from B. caricai n.sp in body posture, position of hemizonid, arrangement of oocytes, presence of reduced spermatheca and absence of males (body straight to slightly curved near vulva, hemizonid adjacent to excretory pore, oocytes arranged in single row, spermatheca well developed and males present in B. caricai n.sp.).

FAMILY ANGUINIDAE NICOLL, 1935 (1926)

Diagnosis : (Modified after Fortuner & Maggenti, 1987). Vermiform nematodes, mature females sometimes swollen. Lip region low, anteriorly flattened, continuous or slightly offset, smooth or faintly annulated. First lip annule not divided into sectors, amphidial apertures, small, elliptical, Lateral fields with four or six and more lines. Deirids and phasmids generally absent. Stylet short and delicate with knobs. Oesophagus with thin or wide procorpus that may or may not be separated from metacorpus by a constriction. Median bulb fusiform to rounded, rarely absent; with or without valve plates. Isthmus thin to wide. Basal glandular part short, may be pyriform or slightly overlapping on intestine. Oesophago-intestinal junction with hyaline cells. Female reproductive system with single gonad, posterior branch reduced to a post-uterine sac or absent. Ovary straight or with flexures. Uterus with four rows of four or more cells, sphincter present at the junction of uterus and vagina. Males similar to females, sexual dimorphism absent. Bursa adanal to terminal.

Type genus : Anguina Scopoli, 1777

Other genera : Halenchus Cobb, 1933
Ditylenchus Filipjev, 1936
Sychnotylenchus Ruhm, 1936
Pseudhalenchus Tarjan, 1958
Thada Thorne, 1941

DITYLENCHUS FILIPJEV,1936

Diagnosis : Low flattened anterior end. Weak labial sclerotization. Stylet small and delicate. Median bulb with or without valve plates, glandular oesophageal portion short or long, may overlap intestine for short or long distance. Ovary short or long and may be flexed, oocytes in one or two rows, columned uterus with four rows of four cells, post-uterine sac present or absent. Males with bursa leptoderan, short, adanal or long but never reaching tail end. Mature females sometimes swollen.

Type species : Ditylenchus dipsaci (Kuhn, 1857) Filipjev,1936

DITYLENCHUS DOMESTICUS n.sp. (Fig.7)

Measurements

Paratype females (n=18) : L=0.67-0.94 (0.81±0.07) mm; a=40.9-49.0 (45.1±2.9); b=5.5-7.1(6.4±0.46);c=9.5-14.0(11.0±1.33); c'=4.5-5.8 (5.0±0.5); V=74.8-78.3(76.5±1.3); stylet=10.5 um; conus=4.0 um; oesophagus=112-142 (128.0±6.5) um; excretory pore=95.5-117.0 (102.0 ± 7.6) um; v-a=94-140 (122.0±15.7) um; tail=62-96(75.6±10.2) um; tail/v-a=0.44-0.81 (0.63±0.09).

Holotype female : L=0.81 mm; a=41.8; b=6.3; c=10.5; c'=4.7; V=78.3; stylet =10.5 um; conus=4.0 um; oesophagus=130 um; excretory pore=102 um; v-a=99 um; tail = 78 um; tail/v-a=0.78.

Paratype males(n=2) : L=0.73-0.74 mm; a=48.6-49.4; b=6.2-6.4; c=10.2-11.2; c'=5.3-5.5;stylet =9.0-10.5 um; conus=4.0 um;

oesophagus=114-120 um; excretory pore = 84-89 um;spicules=18 um; gubernaculum = 7.5 um; bursa=40-51 um; tail=66-72 um.

Description

Female : Body under 1.0 mm, straight or curved at vulva, narrow at lip and tail regions. Cuticle finely striated, each striae 1.0-1.5 um apart at midbody. Lateral fields with 6 lines, outer distinctly crenate, originating near spear base and terminating on posterior third of tail, occupying 28-33% of body width. Lip region continuous, low, flat, indistinctly annulated, 3 um high, 7.5 um wide. Cephalic framework inconspicuous. Stylet small, well developed, conus about 40% of stylet length, needle-like.Knobs thick, flang-like, sloping backwards,2.5 um wide. Dorsal oesophageal gland opening 1.5-2.0 um behind spear base. Procorpus tubular, 27-35 um long. Metacorpus oval, 12-18 um long without valve-plates. Isthmus narrow, 28-41 um long. Basal bulb elongate, 26-35 um long with flat or irregular base. Cardia not visible. Two large cells present at oesophago-intestinal junction. Nerve ring 70-98 um from anterior end. Excretory pore very distinct, 90-116 um from anterior end, duct distinct 2.0-2.5 body widths long. Hemizonid not visible.

Gonad monoprodelphic. Oocytes arranged in single row. Vulva a transverse slit. Vagina half of vulval body width deep, at right angles to body axis. Uterus well developed, muscular region followed by quadricolumella. Spermatheca oblong,40-60 um long. Post-uterine sac 21-33 um or 1.10-1.57 times vulval body

diameter long. Rectum distinct, about 3/4th anal body diameter long. Tail elongate, cylindrical in posterior part, 0.44-0.81 times vulva-anus distance long, tip rounded to subclavate.

Male : Similar to female. Spicules well developed. Gubernaculum simple,curved. Bursa faintly crenate, covering half of tail length.

Type habitat and locality : Soil around the roots of tomato (Lycopersicum esculentum) from Aligarh, Uttar Pradesh.

Type specimens

Holotype : Female on slide Ditylenchus domesticus n.sp./1; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Paratypes : Females and males on slides Ditylenchus domesticus n.sp./2-9; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Diagnosis and relationship :

Ditylenchus domesticus n.sp. is characterized by a large body, six lateral lines with outer ones crenate, a nonvalvate metacorpus, basal bulb elongated with flat or irregular base, post-uterine sac 1.10-1.57 vulval body diameters long, a cylindrical tail tapering to rounded or subclavate terminus and bursa enveloping half of tail.

The new species comes close to D. citri (Varaprasad, Khan & Lal,1980) Fortuner & Maggenti, 1987; D. hexaglyphus (Khan & Siddiqi,1968) Fortuner & Maggenti, 1987; D. similis (Thorne &

Malek, 1968) Fortuner & Maggenti,1987; D. taylori (Husain & Khan, 1974) Fortuner & Maggenti, 1987; D. tuberosus (Kheiri, 1971) Fortuner & Maggenti, 1987 and D. varaprasadi (Varaprasad, Khan & Lal, 1980) Fortuner & Maggenti,1987 in having six lateral lines, conspicuous stylet knobs, nonvalvate metacorpus, non-offset basal bulb and a rounded tail terminus. However, it differs from D. citri in the nature of outer lines of lateral fields, absence of overlapping and chamber surrounding basal bulb, shape of tail and percentage of tail covered by bursa (outer lateral lines smooth, distinct chamber surrounding basal bulb, basal bulb overlapping intestine; tail tapering, sub-acute, terminus pointed and bursa enveloping 75% of tail in D. citri).It differs from D. hexaglyphus in having longer stylet conspicuously developed knobs, differently shaped basal bulb, longer post-uterine sac and in shape and length of tail (stylet 7.5-8.5 um long, stylet knobs very small, basal bulb pyriform, length of post-uterine sac equal to vulval body diameter,tail conical, 51-62 um long in D. hexaglyphus). It differs from D. similis in having crenate outer lateral lines, position of metacorpus, position of vulva, tail shape and length of bursa (outer lateral lines smooth, metacorpus anterior to middle of oesophagus, V=84, tail conoid and bursa overlapping 75% of tail in D. similis). It can be differentiated from D. taylori in body length, shape of oesophageal basal bulb, tail and bursa length (L=420-620 um; basal bulb pyriform, tail conical and bursa covering more than half of tail in D. taylori). It also differs from D. tuberosus in the nature of outer lines of lateral fields,

position of metacorpus, length of post-uterine sac and tail shape (outer lines of lateral fields smooth, metacorpus at 32-41% of oesophagus, post-uterine sac more than two vulval body widths long and tail conoid with round terminus in D. tuberosus). From D. varaprasadi it differs in having crenate outer lines of lateral fields, longer spear, oesophageal basal bulb without sheath, absence of peg-like projection of basal bulb into intestine (outer lines of lateral fields smooth, stylet 6-8 um long, basal bulb with a distinct sheath and a peg-like projection of basal bulb into intestine present in D. varaprasadi).

FAMILY BELONOLAIMIDAE WHITEHEAD, 1960

Diagnosis : (Modified after Fortuner & Luc, 1987) Medium to large-sized nematodes. Lip region continuous to offset, labial sclerotization weak to medium. Face view with first lip annule, six-sectored or lateral sectors regressed. Female reproductive system amphidelphic, exceptionally monoprodelphic. Columned uterus with three rows of cells. Tail cylindroid to conoid, more than twice as long as wide. Phasmids small, on posterior half of tail. Deirids present or absent. Males with peloderan bursa, rarely lobed or subterminal. Spicules with or without velum.

Type subfamily : Belonolaiminae Whitehead, 1960

Other subfamily : Telotylenchinae Siddiqi, 1960

SUBFAMILY TELOTYLENCHINAE SIDDIQI, 1960

Diagnosis : Lip region continuous or with slight indentation, face view with six lip sectors or with lateral lip sectors regressed. Labial disc lemon-shaped or variously fused with lip sectors, disc and lip sectors sometimes fused together, sensillae openings often visible on the submedian lip sectors. Cephalic framework with weak to medium sclerotization. Stylet 15-40 um long, with cone about as long as shaft. Procorpus not enlarged, metacorpus with medium-sized valve plates. Female gonad didelphic - amphidelphic or monoprodelphic. Tail cylindroid to conoid..

Type genus : Tylenchorhynchus Cobb, 1913

Other genera : Trophurus Loof, 1956

Trichotylenchus Whitehead, 1960

Nagelus Thorne & Malek, 1968

Paratrophurus Arias, 1970

Merlinius Siddiqi, 1970

Triversus Sher, 1974

Amplimerlinius Siddiqi, 1976

TYLENCHORHYNCHUS COBB, 1913

Diagnosis : Body medium-sized, 1 mm or less long. Cuticle fine to prominently annulated, may be marked by longitudinal striae or ridges. Lateral fields with two, three, four or five lines, sometimes areolated. Cephalic region offset or continuous, annulated or rarely smooth. In SEM lip region shows labial disc fused with first lip annule and lateral sectors reduced. The remaining submedian sectors give a distinct quadrangular appearance in face view. Papillae may be present on submedian sectors. Head continuous to slightly offset. Stylet 15-30 um long, moderately developed, conus as long as shaft, sometimes needle-like. Deirids generally absent. Female tail conoid to subcylindroid, about three times anal body width long, sometimes with thicker cuticle on tip. Male tail enveloped with simple bursa, rarely lobed. Spicules distally flanged with well developed velum.

Type species : Tylenchorhynchus cylindricus Cobb, 1913

TYLENCHORHYNCHUS COFFEAE SIDDIQI & BASIR, 1959

Measurements

Females (n=15) : L = 0.62-0.71 (0.65±0.04) mm; a = 29.7-33.1 (31.2±1.2); b = 4.9-5.8 (5.3±0.30); c = 12.5-13.8 (13.5±0.79); c' = 3.3-4.0 (3.7±0.21); V = 51.6-55.0 (53.5±1.1); stylet = 16.5-19.5 (18.0±0.80) um; conus = 7.5-9.0 (8.8±0.89) um; oesophagus = 115-127 (121.8±5.4) um; excretory pore = 98-107 (102.5±2.9) um; tail = 45-57 (47.8±3.9) um.

Males (n=2) : L = 0.63-0.68 mm; a = 32.7-34.2; b = 5.2-5.5; c = 15.7-17.3; c' = 2.4-2.6; stylet = 18.0 um; conus = 9.0 um; oesophagus = 114-117 um; excretory pore = 100-103 um; spicules = 25.5-27.0 um; gubernaculum = 15.0 um; bursa = 64.0-70.5 um; tail = 40.5-42.0 um.

Host and locality : Soil around roots of wheat (Triticum aestivum) from Dehradun, Uttar Pradesh.

Remarks : The measurements and description of present specimens agree well with those given by Siddiqi et al. (1982).

TYLENCHORHYNCHUS GOFFARTI STURHAN, 1966

Measurements

Females (n=10) : L = 0.47-0.64 (0.57±0.05) mm; a = 30.7-37.5 (34.6±2.7); b = 4.3-5.9 (5.2±0.5); c = 13.0-14.7 (14.1±0.53);

c' = 3.0-3.5 (3.2±0.23); V = 50.9-56.6 (54.3±1.9); stylet = 12.0 um; conus = 5.0 um; oesophagus = 104-114 (108.3±3.9) um; excretory pore = 82-100 (88.4±6.3) um; tail = 34.5-45.0 (40.5±3.1) um.

Males (n=5) : L = 0.48-0.53 (0.50±0.02) mm; a = 31.2-35.8 (33.1±1.6); b = 4.6-5.4 (4.8±0.28); c = 10.4-14.2 (13.0±1.4); c' = 2.7-3.7 (3.3±0.35); stylet = 12.0 um; conus = 5.0 um; oesophagus = 93-114 (103.6±6.7) um; excretory pore = 80-88 (84.7±2.9) um; spicules = 21-24 (22.0±1.1) um; gubernaculum = 10-12 (11.0±0.8) um; bursa = 54-60 (56.5±2.0) um; tail = 34.5-39.0 (36.8±1.5) um.

Host and locality : Soil around roots of wheat (Triticum aestivum) from Chamoli, Uttar Pradesh.

Remarks : The measurements and characters of present specimens agree well with the original description given by Sturhan (1966).

TYLENCHORHYNCHUS LEVITERMINALIS SIDDIQI, MUKHERJEE & DASGUPTA, 1982

(Fig. 8 A-D)

Measurements

Females (n=8) : L = 0.51-0.67 (0.61±0.05) mm; a = 31.2-37.2 (33.4±2.7); b = 4.5-5.4 (5.0±0.33); c = 12.3-14.7 (13.7±0.75); c' = 3.2-4.0 (3.5±0.29); V = 53.5-55.8 (54.9±0.77); stylet = 16.5-18.0 (17.7±0.52) um; conus = 9.0 um; oesophagus = 110.0-126.5 (120.4±5.0) um; excretory pore = 83-99 (94.5±5.8) um; tail = 42-48 (44.5±2.07) um.

Males (n=8) : L = 0.51-0.61 (0.56±0.03) mm; a = 31.1-34.0 (32.1±1.3); b = 4.4-5.1 (4.7±0.23); c = 12.4-15.1 (13.6±0.95); c' = 2.6-2.9 (2.7±0.2); stylet = 18.0 um; conus = 9.0 um; oesophagus = 116-124 (118.5±2.5) um; excretory pore = 93-99 (95.5±2.5) um; spicules = 21.0-25.5 (23.0±1.4) um; gubernaculum = 12.0-13.5 (13.2±0.52) um; bursa = 57-66 (61.2±3.5) um; tail = 39-54 (41.2±1.8) um.

Host and locality : Soil around roots of paddy (Oryza sativa) from Nowgong, Assam.

Remarks : This species was originally described as a subspecies of Tylenchorhynchus crassicaudatus by Siddiqi et al. (1982). Later Siddiqi (1986) raised it to species rank and made T. paranudus Phukan & Sanwal, 1982 a junior synonym of the species. Vovlas & Cheng (1988) redescribed this species from China. The measurements and description of present specimens closely conform with the original description.

TYLENCHORHYNCHUS MANGIFERAE KHAN, M.L. & KHAN, S.H., 1986

Measurements

Females (n=15) : L = 0.49-0.60 (0.55±0.03) mm; a = 33.1-37.3 (34.9±1.5); b = 4.5-5.2 (4.9±0.35); c = 13.2-14.8 (14.2±0.73); c' = 3.0-3.5 (3.3±0.12); V = 54.5-60.5 (56.8±1.7); stylet = 12.0-13.5 (12.3±0.66) um; conus = 6.0 um; oesophagus = 102-120 (110.7±5.5) um; excretory pore = 85.5-90.0 (88.1±1.9) um; tail = 34.5-42.0 (38.5±2.3)um.

Males (n=2) : L = 0.41-0.51 mm; a = 27.3-30.9; b = 4.2-4.6; c = 10.9-12.1; c' = 2.7-3.3; stylet = 12.0 um; conus = 6.0 um; oesophagus = 90-120 um; excretory pore = 76-84 um; spicules = 25.5-27.0 um; gubernaculum = 13.5-15.0 um; bursa = 50-63 um; tail = 37.5-42.0 um.

Host and locality : Soil around roots of Papaya (Carica papaya) from Haldwani, Uttar Pradesh.

Remarks : The measurements and description of present specimens agree well with those of Khan, M.L. and Khan, S.H. (1986) except that the present specimens have a slightly posteriorly located vulva and slightly longer spicules and gubernaculum.

TYLENCHORHYNCHUS MASHHOODI SIDDIQI & BASIR, 1959

(Fig . 8 E-H)

Measurements

Trichur, Kerala population

Females (n=10) : L = 0.60-0.74 (0.68±0.04) mm; a = 33.0-35.6 (33.8±1.2); b = 5.0-5.8 (5.5±0.26); c = 12.8-15.1 (14.3±0.68); c' = 3.0-4.1 (3.5±0.33); V = 48.6-56.8 (54.5±2.3); stylet = 18.0-19.5 (18.6±0.72) um; conus = 7.5-9.0 (8.4±0.72) um; oesophagus = 112-130 (123.0±6.0) um; excretory pore = 94.0-109.5 (101.5±5.7) um; tail = 45-56 (48.0±4.4) um.

Males (n=10) : L = 0.57-0.70 (0.65±0.06) mm; a = 31.2-36.2 (34.5±2.0); b = 4.9-5.5 (5.3±0.27); c = 13.2-14.7 (13.9±0.61); c' = 3.0-3.8 (3.6±0.33); stylet = 18.0-19.5 (18.5±0.70) um; conus = 9.0 um; oesophagus = 116-129 (123.6±5.5) um; excretory pore = 102.0-109.5 (105.6±3.1) um; spicules = 24-27 (25.0±1.4) um; gubernaculum = 16.5-18.5 (17.2±1.4) um; bursa = 60-80 (70.6±8.2) um; tail = 41.5-52.5 (47.2±4.7) um.

Guntur, Andhra Pradesh population

Females (n=10) : L = 0.57-0.77 (0.67±0.07) mm; a = 28.1-36.2 (31.4±2.5); b = 4.5-6.0 (5.5±0.47); c = 12.6-14.8 (14.0±8.6); c' = 3.1-3.8 (3.5±0.22); V = 52.7-59.8 (55.0±2.8); stylet = 18-21 (18.9±0.83) um; conus = 8.5-9.5 (8.9±0.49) um; oesophagus = 110-131 (124.3±7.2) um; excretory pore = 102-110 (106.5±2.9) um; tail = 43-52 (47.4±2.5) um.

Males (n=2) : L = 0.64-0.78 mm; a = 31.2-33.5; b = 5.1-5.7; c = 14.5-15.6; c' = 2.6-2.7; stylet = 21.0 um; conus = 9.5 um; oesophagus = 110-118 um; excretory pore = 99-108 um; spicules = 27.0-28.5 um; gubernaculum = 13.7-15.0 um; bursa = 72.0-75.5 um; tail = 42-45 um.

Balehonnur, Karnataka population

Females (n=8) : L = 0.64-0.73 (0.67±0.04) mm; a = 30.5-32.6 (31.5±0.78); b = 4.8-5.9 (5.5±0.41); c = 14.5-15.8 (15.3±0.35);

c' = 3.3-3.5 (3.4±0.06); V = 53.4-56.2 (55.3±1.0); stylet = 19.5-21.0 (20.6±0.64) um; conus = 9-10 (9.4±0.48) um; oesophagus = 116-132 (122.5±5.6) um; excretory pore = 96-105 (100.5±3.0) um; tail = 42.0-46.5 (43.8±1.9) um.

Males : Not found

Host and localities : Soil around the roots of (i) banana (Musa paradisiaca) from Trichur, Kerala (ii) banana (Musa paradisiaca) from Guntur, Andhra Pradesh (iii) cardmom (Eletaria cardomum) from Balehonnur, Karnataka.

Remarks : Tylenchorhynchus mashhoodi is a very common species of the genus in India. Baqri & Jairajpuri (1970) studied intraspecific variations of the species and observed that length and shape of tails, number of tail annules (14-29), length of spear (16-19 um), length and shape of spicules and gubernaculum showed great variations. On this basis they synonymized T. crassicaudatus Williams, 1960; T. dactylurus Das, 1960; T. digitatus Das, 1960; T. elegans Siddiqi, 1961 and T. zeae Sethi & Swarup, 1968 with T. mashhoodi. Later Siddiqi (1986) and Fortuner & Luc (1987) revalidated all these species. In our study it was observed that this species shows variations in stylet length; tail length and number of tail annules, but the shape of lip region and tail are consistent characters.

TYLENCHORHYNCHUS PHASEOLI SETHI & SWARUP, 1968

Measurements

Females (n=15) : L = 0.71-0.75 (0.73±0.01) mm; a = 33.3-39.3 (36.7±2.0); b = 5.2-5.6 (5.4±0.16); c = 15.3-18.0 (16.5±1.1); c' = 2.7-3.2 (3.0±0.15); V = 52.8-54.8 (53.4±0.71); stylet = 18-21 (20.0±0.59) um; conus = 9.5-11.0 (10.1±0.69) um; oesophagus = 130-145 (134.9±5.1) um; excretory pore = 109.5-120.0 (114.5±3.6) um; tail = 41-48 (44.7±2.8) um.

Males (n=10) : L = 0.62-0.69 (0.65±0.02) mm; a = 33.6-36.4 (34.8±1.1); b = 4.7-5.3 (5.0±0.22); c = 12.7-13.6 (13.1±0.38); c' = 3.3-3.7 (3.5±0.13); stylet = 18-21 (20.0±0.42) um; conus = 9.5-11.0 (10.2±0.53) um; oesophagus = 130-136 (132.0±2.4) um; excretory pore = 99-112 (106.3±4.4) um; spicules = 24-27 (25.2±0.58) um; gubernaculum = 12.0-13.5 (12.7±0.65) um; bursa = 54-68 (61.2±5.7) um; tail = 48.0-52.5 (49.6±0.65) um.

Host and locality : Soil around the roots of sweet pea (Pisum sativum) from Aligarh, Uttar Pradesh.

Remarks : This species is common in Rajasthan and Uttar Pradesh (Mulk & Jairajpuri, 1972). Measurements and description agree well with the original description given by Sethi & Swarup (1968) and Mulk & Jairajpuri (1972).

TYLENCHORHYNCHUS CAPITATUS (ALLEN, 1955) SIDDIQI, 1971

Measurements

Chamoli, Uttar Pradesh population

Females (n=15) : L = 0.66-0.79 (0.71±0.03) mm; a = 34.1-37.6 (36.1±1.1); b = 4.8-5.7 (5.2±0.31); c = 14.5-16.4 (15.4±0.67); c' = 3.0-3.5 (3.2±0.18); V = 53.2-56.9 (54.6±1.2); stylet = 15.0-16.5 (16.3±0.47) um; conus = 9.0 um; oesophagus = 130-148 (138.2±5.7) um; excretory pore = 107-118 (112.4±3.3) um; tail = 40.5-48.0 (46.3±2.3) um.

Males : Not found.

Host and locality : Soil around the roots of paddy (Oryza sativa) from Chamoli, Uttar Pradesh.

Remarks : The measurements and characters of present specimens closely agree with the description of Tylenchorhynchus capitatus given by Allen (1955) and Jairajpuri (1985).

TYLENCHORHYNCHUS ROSENSIS n.sp.

(Fig. 9)

Measurements

Paratype females (n=12) : L = 0.6-0.7 (0.66±0.03) mm; a = 29.8-35.5 (32.2±1.8); b = 4.5-5.5 (5.1±0.17); c = 13.0-17.4 (15.5±1.4); c' = 2.7-4.0 (3.2±0.46); V = 53.5-57.8 (55.5±1.5); stylet = 18.0-19.5 (18.6± 0.74) um; conus = 9.0 um; oesophagus = 120-138 (129.9±7.1) um;

excretory pore = 93-111 (100.7±6.2) um; tail = 36.0-49.5 (43.6±3.9) um.

Holotype female : L=0.69 mm; a= 35.4; b = 5.2; c = 15.3; c' = 3.3; V = 57.8; stylet = 19.5 um; conus = 9 um; oesophagus = 132 um; excretory pore = 110 um; tail = 45 um.

Paratype males (n = 8) : L= 0.65-0.72 (0.67±0.02) mm; a = 32.2-35.4 (33.9±1.1); b = 5.0-5.8 (5.3 ± 0.27); c = 14.0 - 16.5(14.8 ± 0.9); c'= 2.4 - 2.6 (2.5 ± 0.73); stylet = 16.5 - 18.0 (17.7 ± 0.60) um; conus = 7.5 - 9.0 (8.4 ± 0.73) um; oesophagus = 126 - 142 (130.7 ± 5.8) um; excretory pore = 96.0 - 106.5 (102.0 ± 3.9) um; spicules = 22.5 - 27.0 (24.6 ± 1.5) um; gubernaculum = 13.5-16.5 (14.7 ± 1.1) um; bursa = 63 - 72 (66.7 ± 3.4) um; tail = 45 - 48 (47.0 ± 1.2) um.

Description

Female: Body ventrally curved upon fixation, narrow at head end. Cuticle transversely striated, each striae 1.5-2.0 um wide at midbody. Lateral fields with four incisures, outer lines crenate, 30 -35% of body width wide, originating at the base of spear and terminating near tail tip. Lip region conoid, continuous with body contour, 3-4 um high, 6.0-7.5 um wide with 4-5 faint annules. Cephalic framework moderately sclerotized. Stylet weak, conus pointed, 48-50% of stylet length. Basal knobs rounded, sloping posteriorly, 2 um high, 4 um wide. Orifice of dorsal oesophageal

gland 4 um behind spear base. Procorpus slender, 36-42 um long, enlarging to a muscular oval metacorpus 15.0 - 16.5 um long, 10 - 12 um wide with 4 um long valve plates. Isthmus slender, 25.0-28.5 um long. Basal bulb slightly oval with flat base, 27-30 um long, 12.0-13.5 um wide. Cardia hemispherical, 3.0-4.5 um long. Nerve ring 80-98 um from anterior end. Excretory pore located near base of isthmus. Hemizonoid anteriorly adjacent to excretory pore. Intestine with fasciculi.

Gonads amphidelphic, outstretched. Oocytes arranged in a single row. Vulva a transverse slit, epiptygma not seen. Vagina muscular, 9.0-10.5 um deep. Uterus with proximal glandular and distal muscular regions. Spermatheca ovoid, 15-18 um long. Tail subcylindrical, bluntly pointed with smooth terminus, 36.0-49.5 um or 2.7-4.0 anal body widths long. Anus pore-like, post-rectal sac present, 1/4 to 1/3 of tail length long. Phasmids small, located slightly anterior to middle of tail. Annules on tail 22-36, cuticle 9-12 um thick.

Male: Similar to females. Spicules arcuate, 22.5-27.0 um long, capitulum round. Gubernaculum simple, arcuate, 13.5-16.5 um long. Bursa with finely crenate margin, 63-72 um long, enveloping tail. Tail long conoid, 45-48 um or 2.4 - 2.6 and body widths long.

Type habitat and locality : Soil around roots of rose (Rosa indica) from Kurnool, Andhra Pradesh.

Type material

Holotype : Female on slide Tylenchorhynchus rosensis n.sp./1; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Paratypes : Females and males on slides Tylenchorhynchus rosensis n.sp./2-10; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Diagnosis and relationship :

Tylenchorhynchus rosensis n.sp. is characterized by a continuous lip region with 4-5 faint annules, moderately sclerotized cephalic region, 16.0-19.5 um long stylet with rounded, posteriorly sloping knobs, outer lateral lines crenate, post-rectal sac about one third of tail length long; tail subcylindrical, bluntly pointed with smooth tip, tail annules 22-36.

The new species comes close to T. bohrrensis Gupta & Uma, 1980; T. coffeae Siddiqi & Basir, 1959; T. ewingi Hopper, 1959; T. goldeni Rashid & Singh, 1982 and T. striatus Allen, 1955 in having continuous annulated lip region and subcylindrical tail with smooth terminus. However, it differs from all related species in having a post-rectal sac. It further differs from T. bohrrensis in having more lip annules, longer stylet, differently shaped spear knobs and greater number of tail annules (lip annules 2-3, stylet 15-17 um long, spear knobs anteriorly directed, tail annules 17-21 in T. bohrrensis). It differs from T. coffeae in having greater number and faint lip annules, oesophageal bulb with flat base and greater number of tail

annules, two very prominent lip annules, oesophageal basal bulb pyriform and offset and tail annules 16-24 in T. coffeae). From T. ewingi it differs in having more lip annules, stronger cephalic sclerotization and greater number of tail annules (lip annules 3, cephalic sclerotization inconspicuous, tail annules 15-19 in T. ewingi). From T. goldeni it differs in having more lip annules and conspicuous cephalic sclerotization (lip annules 2-3, cephalic sclerotization inconspicuous in T. goldeni). From T. striatus it differs in shape of stylet knobs and smaller spicules (stylet knobs anteriorly directed, spicules 20 um long in T. striatus).

TYLENCHORHYNCHUS CHERAPUNJII n.sp.

(Fig. 10)

Measurements

Paratype females (n =10): L = 0.70 - 0.79 (0.75 ± 0.02) mm; a = 33.0 - 36.9 (34.5 ± 1.4); b = 5.3 - 5.9 (5.6 ± 0.24); c = 13.8 - 16.8 (15.9 ± 1.0); c' = 2.7 - 3.5 (2.9 ± 0.16); V = 51.9 - 56.5 (54.2 ± 1.5); stylet = 18 um; conus= 9 um; oesophagus = 126 -143 (134.0 - 5.7) um; excretory pore = 95 - 104 (98.8 ± 3.0) um; tail = 45 - 52(47.5 ± 2.8) um.

Holotype female: L = 0.76 mm; a = 33.7; b = 5.5; c = 16.8; c' = 2.7; V = 56.5; stylet =18.0 um; conus =9.0 um; oesophagus = 138 um; excretory pore = 98 um; tail = 45 um.

Paratype males (n = 4) : L = 0.73 - 0.82 (0.77 ± 0.03) mm; a = 35 - 39 (36.9 ± 1.6); b = 5.5 - 6.3 (5.8 ± 0.36); c = 13.3 - 16.4 (14.7 ± 1.3); c' = 2.9 - 3.8 (3.3 ± 0.39); stylet = 16.5 - 18.0 (17.2 ± 0.75) um; conus = 8.5 um; oesophagus = 122.0 - 145.5 (134.7 ± 8.5) um; excretory pore = 88 - 106 (95.2 ± 6.7) um; spicules = 23.5 - 27.5 (25.5 ± 2.5) um; gubernaculum = 12.0 - 13.5 (12.5 ± 0.70)um; bursa = 75 - 90 (81.0 ± 6.5) um; tail = 46.0 - 61.5 (53.0 ± 6.3) um.

Description

Female : Body ventrally arcuate upon fixation, narrow at head and tail ends. Cuticle transversely striated, each striae 1.5-2.0 um wide at midbody. Lateral fields with four incisures, occupying 30 - 35% body width at midbody. Outer lines regularly areolated in anterior and posterior region and irregularly areolated on rest of the body, originating at spear base and terminating near tail tip. Lip region round, continuous, slightly narrow anteriorly, 4.5 um high, 7.5 um wide with four distinct annules. Cephalic framework moderately sclerotized. Stylet well developed. Conus about 50% of stylet length. Basal knobs slightly anteriorly directed, 3 um high,4.5 um wide. Dorsal oesophageal gland opening 3 um behind spear base. Procorpus slender, 32-40 um long, metacorpus oval, 15 - 18 um long, 10.5-12.0 um wide with 4.5 um long valve plates. Isthmus slender, 28-37 um long. Basal bulb oval with flat base, 26-36 um long, 15.0 - 16.5 um wide. Cardia 4.5 um long, tongue-shaped. Nerve ring 78-90 um from

anterior end. Excretory pore 95 - 104 um from anterior or near base of isthmus. Hemizonid 4 um wide, one annule anterior to excretory pore. Intestine with fasciculi.

Gonads amphidelphic, outstretched, Oocytes arranged in a single row. Vulva a transverse slit, epiptygma absent. Vagina muscular 7.5 - 9.0 um deep. Uterus with proximal glandular and distal muscular regions. Spermatheca slightly oval, 12-15 um in diameter. Tail subcylindrical with 20-25 annules, bluntly rounded, terminus annulated, 45-52 um or 2.7-3.5 anal body widths long. Anus pore-like, post-anal sac about one third tail length long. Phasmids small, pore-like, anterior to middle of tail. Cuticle on tail 7-8 um thick.

Male : Similar to females. Spicules arcuate, 23.5-27.0 um long with round capitulum. Gubernaculum curved, 12.0-13.5 um long. Bursa with crenate margins, 75-90 um long. Tail conoid, 46.0 - 61.5 um or 2.9 - 3.8 anal body widths long.

Type habitat and locality : Soil around the roots of paddy (Oryza sativa) from Cherapunji, Meghalaya.

Type material

Holotype : Female on slide Tylenchorhynchus cherapunjii n.sp/1; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Paratypes : Females and males on slides Tylenchorhynchus cherapunjii n.sp/2-12; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Diagnosis and relationship

Tylenchorhynchus cherapunjii n.sp. is characterized by a round continuous, lip region with four annules; stylet 16.5 - 18.0 um long; regular areolation in the outer lines in anterior and posterior ends; presence of post-rectal sac and a subcylindrical, bluntly rounded tail with 20 - 25 annules and terminus annulated.

The new species comes close to T. brevicaudatus Hopper, 1959; T. bryobius Sturhan, 1966; T. eremicolus Allen, 1955; T. huesingi Paetzold, 1958 and T. parvus Allen, 1955 in having continuous, annulated lip region and annulated tail tip. However, it differs from all these species except T. huesingi in having a subcylindrical, bluntly rounded tail and a post-rectal sac. It further differs from closest species T. eremicolus in having a smaller stylet, fewer tail annules and longer spicules and gubernaculum (stylet 19-20 um long, tail annules 27-29, spicules 22 um and gubernaculum 9 um long in T. eremicolus). From T. brevicaudatus it further differs in having a smaller body, fewer lip annules, moderately sclerotized lip region; smaller stylet, longer oesophagus and tail; smaller spicules and more tail annules (L = 1.28 - 1.37 mm; lip annules eight; lip region heavily sclerotized, stylet 37-38 um long, b = 6.7 - 6.9; c = 34-44;

spicules 32 um long and tail annules 37-38 in T. brevicaudatus). From T. bryobius it differs in having lesser lip annules, smaller stylet and lesser tail annules (lip annules 5-6, stylet 21-24 um long and tail annules 35 - 45 in T. bryobius). From T. huesingi it differs in having lesser lip annules, differently shaped stylet knobs, smaller spicules, higher c'value and lesser tail annules (lip annules 5, stylet knobs posteriorly directed, spicules 30 um long, c' = 2.0 and tail annules 32 - 36 in T. huesingi). From T. parvus it also differs in having lesser lip annules, differently shaped stylet knobs; longer spicules and gubernaculum, lesser tail annules (lip annules 7; stylet knobs laterally directed, spicules 12 um, gubernaculum 5 um long and tail annules 35-43 in T. parvus).

MERLINIUS SIDDIQI, 1970

Diagnosis : Body medium-sized (about 1 mm or longer). Lateral fields with six incisures. Deirids present at level where lateral field has four lines only. Cephalic region continuous to slightly offset. In SEM lip region with oval labial disc surrounded with six-sectored first lip annule. Submedian sectors somewhat flattened, labial annules broken by 6 radial grooves or striations. Stylet usually medium-sized, 20-25 um long, sometimes shorter (10 um) or longer (40-50 um), cone needle-shaped. Male spicules without velum, cylindroid, with blunt tip. Gubernaculum non-protrusible.

Type species : Merlinius brevidens (Allen, 1955) Siddiqi, 1970

MERLINIUS BREVIDENS (ALLEN, 1955) SIDDIQI, 1970

Measurements

Females (n=10) : L = 0.52-0.68 (0.57±0.05) mm; a = 30.5-38.6 (32.5±2.5); b = 4.4-5.7 (4.9±0.38); c = 12.5-16.2 (13.5±1.2); c' = 3.0-3.6 (3.2±0.22); V = 52.0-57.6 (54.3±3.0); stylet = 13-15 (14.2±0.75) um; conus = 6.0 um; oesophagus = 103-127 (116.7±7.6) um; excretory pore = 87-91 (88.6±1.5) um; tail = 39.7-43.0 (42.2±1.5) um.

Males : Not found.

Host and locality : Soil around roots of wheat (Triticum aestivum) from Aligarh, Uttar Pradesh.

Remarks : The present specimens closely agree with the descriptions of M. brevidens as given by Allen (1955) and Siddiqi (1961 & 1972a).

MERLINIUS ORIENTALIS n.sp.

(Fig. 11)

Measurements

Paratype females (n=10) : L = 0.77-0.89 (0.81±0.04) mm; a = 28.0-34.2 (31.1±2.5); b = 5.2-5.8 (5.6±0.20); c = 14.2-14.9 (14.5±0.22); c' = 2.7-3.0 (2.9±0.05); V = 55-59 (56.0±1.7); stylet = 25.5=28.5 (26.0±0.70) um; conus = 12-15 (13.5±1.2) um; oesophagus = 138-153 (143.5±5.0) um; excretory pore = 113-130 (122.7±6.9) um; tail = 52.5-60.0 (55.5±2.6) um.

Holotype female : L = 0.82 mm; a = 34.2; b = 5.7; c = 14.4; c' = 2.9; V = 55.0; stylet = 27.0 um; conus =15.0 um; oesophagus = 142.5 um; excretory pore = 123.0 um; tail = 57.0 um.

Paratype males (n=6) : L = 0.56-0.84 (0.73±0.08) mm; a = 25.6-36.2 (32.2±3.2); b = 4.0-5.5 (5.0±0.5); c = 9.6-12.1 (11.4±1.1); c' = 3.0-4.0 (3.4±0.35); stylet = 25.5-28.5 (27.2±1.3) um; conus = 12.0-13.5 (12.7±0.75) um; oesophagus = 140-155 (146.0±6.7) um; excretory pore = 106-120 (113.7±5.1) um; spicules = 27-30 (27.8±0.98) um; gubernaculum = 11.0-12.5 (11.3±0.38) um; bursa = 76.0-98.0 (92.9±5.6) um; tail = 57-72 (64.2±4.6) um.

Description

Female : Body ventrally arcuate upon fixation, narrow at head and tail ends. Cuticle transversely striated, each striae about 1.5-2.0 um wide at midbody. Lateral fields with six incisures, 30-35% of body width, outer lines areolated in the oesophageal region, smooth on rest of body; originating at base of spear and terminating near the tail tip. Lip region round, setoff by a constriction, 5-6 um high, 8.0-9.5 um wide with 6-7 fine annules. Cephalic framework strongly sclerotized. Stylet not strong; conus pointed. Basal knobs round, 2 um high, 5 um wide. Dorsal oesophageal gland opening 3 um behind spear base. Procorpus slender, 32-40 um long. Metacorpus muscular, 16-19 um long, 11-12 um wide with 4.5-6.0 um long valve plates. Isthmus slender, 34-41 um long. Basal bulb oval with hemispherical base, 21-27 um long, 11.0-12.5 um wide. Cardia hemispherical, 3 um long. Nerve ring 96-110 um from anterior end. Excretory pore near base of isthmus, 115-130 um from anterior end. Hemizonid anteriorly adjacent to excretory pore. Deirids distinct, pore-like near the level of excretory pore.

Gonads amphidelphic, outstretched. Oocytes arranged in single row. Vulva a transverse slit, epiptygma single, located on anterior vulval lip. Vagina muscular, 10.5-12.0 um deep. Uterus with proximal glandular and distal muscular regions. Spermatheca spherical, 15-18 um in diameter. Tail subcylindrical, bluntly rounded with smooth terminus, 52.5-60.0 um or 2.7-3.0 anal body widths long. Anus pore-like, phasmids located near middle of tail. Cuticle 9.0-10.5 um thick at terminus.

Male : Similar to females but smaller in size. Spicules arcuate, 27-30 um long, capitulum round. Gubernaculum simple, arcuate, 11.0-12.5 um long. Bursa with finely crenate margins, 76-98 um long, enveloping tail. Tail elongate conoid, tip smooth, 57-72 um or 3-4 anal body widths long.

Type habitat and locality : Soil around the roots of Paddy (Oryza sativa) from Aligarh, Uttar Pradesh.

Type material

Holotype : Female on slide Merlinius orientalis n.sp./1; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Paratypes : Females and males on slides Merlinius orientalis n.sp./2-10; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Diagnosis and relationship

Merlinius orientalis n.sp. is characterized by a medium-sized body, a setoff, heavily sclerotized lip region with 6-7 annules, stylet 27-30 um long; V = 55-59 and tail subcylindrical, bluntly rounded with smooth terminus.

The new species comes close to Merlinius grandis (Allen, 1955) Siddiqi, 1970; M. laminatus (Wu, 1969) Siddiqi, 1970; M. lineatus (Allen, 1955) Siddiqi, 1970 and M. tatrensis (Sabova, 1967) Tarjan, 1973 in having a setoff lip region, absence of longitudinal lines, stylet less than 30 um long, small phasmids and smooth tail terminus. However, it differs from the closest species, M. grandis in having a smaller body, strongly sclerotized lip region, lateral lines areolated in oesophageal region and posteriorly located vulva (L = 960-1110 um, lip region sclerotized but only at basal region, lateral lines smooth not areolated in oesophageal region and V = 50-54 in M. grandis). From M. laminatus it differs in having smaller "b" value, longer stylet, posteriorly located vulva, and in tail shape (b = 6.0-7.3; stylet = 20-21 um long; V = 52-55 and tail cylindrical in M. laminatus). From M. lineatus it differs in having well sclerotized lip region, smaller oesophagus and tail, and posteriorly located vulva (lip region weakly sclerotized, b = 4.8-5.0, c = 12-13; V = 51-53 in M. lineatus). It can be differentiated from M. tatrensis in having longer stylet, higher "b" value, higher c' value and in the presence of males (stylet 23-24 um long; b = 4.3-4.4; c' = 2.3-2.6 and males absent in M. tatrensis).

FAMILY **PRATYLENCHIDAE** THORNE, 1949

Diagnosis : (Modified after Luc, 1987). Marked sexual dimorphism frequent. Lip region low, rounded or flattened anteriorly, continuous or slightly setoff from body, labial framework heavily sclerotized. Amphidial apertures small, slit-like. Spear strong, basal knobs well developed, rounded or flat anteriorly. Median oesophageal bulb strong, rounded or oval with valve plates. Oesophageal glands lobe-like, overlapping anterior end of intestine, rarely abutting. Deirids absent. Female genital tract single or double. Tricolumellar uterus. Epiptygma absent. Phasmids pore-like. Males with bursa terminal or subterminal. Tail shape variable from cylindrical to conoid.

Type subfamily : Pratylenchinae Thorne, 1949

Other subfamily : Nacobbinae Chitwood, 1950

SUBFAMILY **PRATYLENCHINAE** THORNE, 1949

Diagnosis : Both sexes vermiform. Tail elongated, longer than two anal body diameters. Phasmids located well behind anal or cloacal level.

Type genus : Pratylenchus Filipjev, 1936

Other genera : Pratylenchoides Winslow, 1958
Apratylenchoides Sher, 1973
Radopholus Thorne, 1949
Zygotylenchus Siddiqi, 1963
Hirschmanniella Luc & Goodey, 1964
Hoplotylus S'Jacob, 1960

PRATYLENCHUS FILIPJEV, 1936

Diagnosis : Body less than 0.8 mm long. No marked sexual dimorphism in anterior region of the body. Lateral fields with 4-6 incisures. Deirids absent. Cephalic region low, flattened anteriorly, continuous or weakly setoff. In SEM, lip region characterized by fusion of labial disc with submedian lip sectors. Lateral lip sectors not reduced. Cephalic sclerotization massive. Stylet 20 um or less with rounded or anteriorly flat or indented basal knobs. Oesophageal glands overlapping intestine ventrally, less than two body widths long. Oesophago-intestinal valve not well developed. Vulva in posterior region of the body. Gonads pseudo-monoprodelphic, with only anterior ovary functional, posterior branch reduced to post-vulval sac. Female tail subcylindrical to conoid, 2-3 anal body widths long, terminus smooth or annulated. Phasmids located near middle of tail. Bursa enclosing tail terminus. Spicules with subterminal pore on dorsal side. Gubernaculum simple, non-protruding.

Type species : Pratylenchus pratensis (De Man, 1880) Filipjev, 1936

PRATYLENCHUS FLAKKENSIS SEINHORST, 1968

Measurements

Females (n=12) : L = 0.54-0.76 (0.61±0.07) mm; a = 32.8-38.5 (34.2±2.0); b = 5.7-7.7 (6.5±0.75); b' = 4.5-5.9 (5.0±0.54); c = 15.2-18.6 (16.0±1.86); c' = 2.8-3.4 (3.1±0.21); V = 73.2-77.6 (75.2±1.5); stylet = 16.5-18.0 (16.8±0.52) um; conus = 8-9 (8.3±0.42) um;

oesophagus = 108-113 (121.0±8.8) um; excretory pore = 84-100 (89.0±5.5) um; v-a = 91-156 (124.0±13.2) um; tail = 35-41 (38.0±2.0) um; tail/v-a = 0.26-0.42 (0.33±0.05).

Males (n=8) : L = 0.51-0.62 (0.56±0.05) mm; a = 30-37 (34.0±3.3); b = 6.0-6.9 (6.5±0.5); b' = 4.9-5.5 (5.2±0.3); c = 16.6-19.5 (18.2±1.7); c' = 2.3-2.9 (2.7±0.34); stylet = 16.5-18.0 (17.2±0.8) um; conus = 8-9 (8.4±0.53) um; oesophagus = 104-112 (107.0±3.0) um; excretory pore = 84-92 (86.5±2.7); spicules = 20.5 um; gubernaculum = 5.0 um; bursa = 45-65 (55.0±8.0) um; tail = 26-35 (30.0±3.6) um.

Host and locality : Soil around roots of tea (Camellia sinensis) from Kaziranga, Assam.

Remarks : The present specimens closely agree with the description of P. flakkensis Seinhorst, 1968. However, minor differences in the form of areolation of lateral fields in posterior third of body and subclavate tail with annulated tip was observed in some specimens.

PRATYLENCHUS ZEAE GRAHAM, 1951

Measurements

Females (n=20) : L = 0.43-0.49 (0.47±0.02) mm; a = 24.2-28.6 (26.5±1.33); b = 4.7-5.4 (5.0±0.2); b' = 3.3-4.0 (3.7±0.3); c = 14.3-20.2 (17.8±2.1); c' = 2.2-2.8 (2.4±0.2); V = 73-80 (76.8±2.0);

stylet = 15-17 (16.7±0.84) um; conus = 7-8 (7.4±0.44) um; oesophagus = 115-154 (129.0±10.0) um; excretory pore = 70-84 (78.0±4.0) um; v-a = 70-86 (83.0±6.6) um; tail = 24-33 (27.0±2.8) um; tail/v-a = 0.28-0.35 (0.31±0.02).

Host and locality : Soil around the roots of coffee (Coffea arabica) from Chikmagalur, Karnataka.

Remarks : The present specimens closely agree with the description of Pratylenchus zeae given by Fortuner (1976). This species is one of the most common species of the genus in India.

HIRSCHMANNIELLA LUC & GOODEY, 1964

Diagnosis : Body long slender, 0.9-4.2 mm long, straight to arcuate upon relaxation. No sexual dimorphism. Lateral fields with 4 incisures. Deirids absent. Lip region flattened anteriorly to hemispherical, continuous. In SEM, lip area characterized by complete fusion of lip sectors, and often with labial disc. Cephalic region strongly sclerotized. Stylet strong, conus tubular, basal knobs large, round. Oesophageal glands elongated, subventral glands larger and much longer than the dorsal gland, nuclei of 3 glands lying in a row. Gonads amphidelphic, both branches equally developed, outstretched in opposite direction. Spermatheca rounded to oval, axial. Tails similar in both sexes, 3 or more times anal body widths long, conoid, usually terminating in a point or mucro. Phasmids located on posterior third of tail. Gubernaculum simple, non-protruding. Bursa crenate, not enveloping tail.

Type species : Hirschmanniella spinicaudata (Schuurmans Stekhoven, 1945) Luc & Goodey, 1964

HIRSCHMANNIELLA GRACILIS (De MAN, 1880) LUC & GOODEY, 1964

Measurements

Females (n=10) : L = 1.48-1.82 (1.64±0.09) mm; a = 52-66 (56.0±4.0); b = 9.5-13.6 (11.2±1.3); b' = 5.0-6.5 (5.4±0.3); c = 15.6-20.0 (17.5±1.4); c' = 4.2-5.0 (4.5±0.3); V = 50-55 (53.0±1.4); stylet = 21-24 (22.0±0.7) um; conus = 10.5-12.0 (11.3±0.74) um; oesophagus = 294-315 (305.0±7.0) um; excretory pore = 116-135 (126.0±6.4) um; tail = 87-99 (94.0±3.5) um.

Males (n=8) : L = 1.54-1.70 (1.64±0.07) mm; a = 54-60 (56.0±2.8); b = 9.5-12.0 (11.0±0.82); b' = 5.2-9.4 (7.0±1.5); c = 17-23 (19.0±2.0); c' = 3.6-5.3 (4.3±0.52); stylet = 19.5-22.5 (20.4±2.0) um; conus = 10.5 um; oesophagus =210-323 (260.0±48.0) um; excretory pore = 120-133 (127.0±5.0) um; spicules = 30-35 (32.6±1.5) um; gubernaculum = 10.5-13.5 (12.3±1.4) um; bursa = 54-90 (78.0±12.0) um; tail = 75-102 (88.0±11.0) um.

Host and locality : Soil around the roots of sugarcane (Saccharum officinarum) from Aurangabad, Maharashtra.

Remarks : The present specimens closely agree with the descriptions given by Sher (1968) and Dey & Baqri (1985).

HIRSCHMANNIELLA ORYZAE (SOLTWEDEL, 1889) LUC & GOODEY, 1964

(Figs.12 & 13)

Measurements

Females (n=20) : L = 1.23-1.50 (1.34±0.85) mm; a = 50.5-60.5 (56.2±3.4); b = 9.6=11.7 (10.6±0.68); b' = 4.1-4.5 (4.3±0.14); c = 17.3-20.9 (19.0±1.3); c' = 3.3-4.5 (4.3±0.33); V = 50.0-56.5 (53.6±1.7); stylet = 15-18 (16.5±1.0) um; conus = 6-8 (7.0±1.0) um; oesophagus = 297-342 (318.0±13.6) um; excretory pore = 100.5-114.0 (105.5±5.0) um; tail = 67.5-76.5 (70.8±3.4) um.

Males (n=10) : L = 1.19-1.30 (1.2±0.2) mm; a = 50.6-55.2 (52.9±1.9); b = 9.1-9.3 (9.2±0.08); b' = 3.9-4.2 (4.1±0.13); c = 18.0-19.5

(18.6±0.52); c' = 4.6-5.0 (4.8±0.14); stylet = 15.0-16.5 (15.9±0.72) um; conus = 6.0-7.5 (6.9±0.73) um; oesophagus = 288-303 (295.8±4.8) um; excretory pore=96-106 (102.0±4.3) um; spicules = 24-27 (26.4±1.2) um; gubernaculum = 9.0-10.5 (9.6±0.72) um; bursa = 65-80 (70.5±4.8) um; tail = 63.0-70.5 (65.5±2.0) um.

Description

Female : Body straight to ventrally curved upon fixation, narrow at head and tail ends. Cuticle transversely striated, each striae 1.5-2.0 um wide at midbody. Lateral fields with four incisures, 30-35% of body width wide, originating from the base of spear and terminating near tail tip; outer ridges partly to completely areolated, inner ridge completely, incompletely or non-areolated. Lip region conoid with rounded terminus, continuous, 4.5-6.0 um high, 8.0-10.0 um wide at base with 4-6 annules. Lip region more or less circular, lip sectors fused. Cephalic disc distinctly protruding, eight linear depressions near the edges of cephalic disc visible. Oral aperture slit-like, located dorso-ventrally. Six labial papillae in the form of pits around oral aperture. Cephalic framework strongly sclerotized. Stylet well developed, strong; conus about 50% of stylet length; basal knobs rounded, 4-5 um wide. Orifice of dorsal oesophageal gland 4.5 um behind spear base. Procorpus 40-48 um long, metacorpus muscular, 15-18 um long and 10-12 um wide with 7.5-9.0 um long sclerotized valve plates. Isthmus slender, 24-30 um long. Oesophageal glands overlapping on ventral side. Nerve ring 80-92 um from anterior end.

Excretory pore 102-114 um from anterior end. Hemizonid anteriorly adjacent to excretory pore.

Gonads amphidelphic, outstretched. Oocytes arranged in double row at tip and posteriorly in single row. Vulva a transverse slit, lips sclerotized. Vagina muscular. Uterus with proximal glandular and distal muscular regions. Spermatheca round or oval shaped, with sperms. Tail long, slender, with mucronate tip. Phasmids small, pore-like on posterior third of tail.

Male : Slightly smaller, more curved than females. Spicules arcuate, capitulum rounded. Gubernaculum slightly arcuate. Bursa with crenate margins, subterminal. Tail long, slender with mucronate tip.

Host and locality : Soil around the roots of motha grass (Cyprus rotandrus) from University Campus, Aligarh, Uttar Pradesh.

Remarks : The measurements and descriptions of the present specimens closely agree with the previous descriptions. SEM of the species supports the observations of Dey & Baqri (1985) that areolation on lateral fields is a variable character and should not be used for species differentiation. The enface view confirms the observations of Lopez & Salazar (1987).

FAMILY **HOPLOLAIMIDAE** FILIPJEV, 1934

Diagnosis : (Modified after Fortuner, 1987). Female vermiform to kidney-shaped. Lip region high, typically higher than ½ the diameter of the basal lip annule, anterior end with rounded or trapezoidal outline in lateral view, annulated, sometimes with longitudinal striae on basal lip annule. Lateral fields generally with four lines, rarely less or absent. Phasmids near anus level, rarely on tail, sometimes migrated anteriorly, pore-like or enlarged or rarely absent. Caudalids and cephalids generally present, deirids absent. Cephalic framework strong with high arches. Stylet strong, 2-3 times maximum width of lip region. Stylet knobs strong, rounded to indented, sometimes anchor-shaped. Dorsal oesophageal gland opening 4-20 um from spear base. Oesophageal glands overlapping the intestine. Oesophago-intestinal junction a small triangular structure. Reproductive system amphidelphic. Gonads outstretched or rarely reflexed, posterior gonad may be reduced. Epiptygma and vulval flaps generally present. Tail typically short, less than two anal body widths long, rarely longer, curved dorsally or regularly rounded or conical. Male with secondary sexual dimorphism, with anterior end less developed than in females, sometimes degenerated or nonfunctional. Bursa enveloping tail or subterminal.

Type subfamily : Hoplolaiminae Filipjev, 1934

Other subfamily : Rotylenchulinae Husain & Khan, 1967

SUBFAMILY **HOPLOLAIMINAE** FILIPJEV, 1934

Diagnosis : Small to moderately large, 0.6-1.5 mm long, vermiform. Sexual dimorphism present in cephalic region. Lateral fields with four lines or less or absent. Deirids absent. Phasmids either small pore-like near anus or large scutellum-like near anus or much anterior to it, anywhere behind oesophageal glands or absent. Caudalids and cephalids present. Cephalic framework and stylet strongly developed. Dorsal oesophageal gland opening more or less far from stylet. Oesophageal glands either of the same size and not overlapping intestine or variously enlarged and overlapping intestine. Ovaries paired, outstretched, both of equal length or posterior branch smaller or reduced. Tail short, more curved dorsally with or without a ventral projection or regularly rounded or rarely conoid. Bursa enveloping tail.

Type genus : Hoplolaimus Daday, 1905

Other genera : Pararotylenchus Baldwin & Bell, 1981
Rotylenchus Filipjev, 1936
Scutellonema Andrassy, 1958
Aorolaimus Sher, 1963
Antarctylus Sher, 1973
Helicotylenchus Steiner, 1945
Aphasmatylenchus Sher, 1965

HOPLOLAIMUS DADAY, 1905

Diagnosis : Body large-sized (1-2 mm long). Lip region offset, wide, anteriorly flat, marked with prominent transverse and longitudinal

striae, basal annule divided into small squares. Cephalic framework heavily sclerotized. In enface view lateral sectors smaller than submedians. Stylet massive with tulip-shaped basal knobs having 1-3 anterior tooth-like projections. Dorsal oesophageal gland opening 3-10 um from stylet base. Oesophageal glands overlap intestine dorsally and laterally, sometimes six gland nuclei may be present. Gonads amphidelphic, both branches outstretched, equally developed. Epiptygma present. Tail short, rounded, tip annulated. Phasmids enlarged to scutella, not opposite to each other, one pre-another post-vulval, exceptionally both post-vulval. Gubernaculum large, protrusible. Secondary sexual dimorphism visible in labial region and oesophageal structures in males.

Type species : Hoplolaimus tylenchiformis Daday, 1905

HOPLOLAIMUS INDICUS SHER, 1963

(Figs.14 A-D & 15)

Measurements

Aligarh, Uttar Pradesh population

Females (n=15) : L = 1.02-1.29 (1.14±0.07) mm; a = 31.2-36.9 (33.9±2.0); b = 8.7-10.6 (9.8±0.61); b' = 7.0-8.3 (7.4±0.4); c = 63.3-76.7 (68.9±5.0); c' = 0.55-0.76 (0.67±0.06); V = 52.8-58.8 (55.4±1.8); stylet = 33.0-37.5 (35.8±1.5) um; conus = 16.5-18.0 (17.3±0.74) um; oesophagus = 143-160 (152.0±5.2) um; excretory pore = 95-115 (105.0±6.3) um; tail = 15.0-19.5 (16.8±1.6) um.

Males (n=10) : L = 0.90-1.10 (1.05±0.06) mm; a = 33.2-38.2 (36.0±1.9); b = 8.5-10.8 (9.6±0.62); b' = 6.4-7.8 (7.1±0.43); c = 33.5-43.5 (39.9±3.3); c' = 1.3-1.5 (1.4±0.09); stylet = 30.0-34.5 (32.6±1.2) um; conus = 15.0-18.0 (16.4±1.08) um; oesophagus = 126-170 (148.0±14.0) um; excretory pore = 88.5-96.0 (92.8±3.0) um; spicules = 33.0-40.5 (37.5±2.4) um; gubernaculum = 18.0-21.0 (19.3±0.9) um; bursa = 48-63 (56.0±5.4) um; tail = 24.0-28.5 (26.8±1.5) um.

Chamoli, Uttar Pradesh population

Females (n=15) : L = 1.10-1.36 (1.19±0.09) mm; a = 30.6-38.2 (34.5±2.6); b = 8.1-10.9 (9.0±0.93); b' = 6-9 (7.4±1.2); c = 42.2-91.7 (55.6±15.8); c' = 0.47-1.0 (0.8±0.18); V = 50.3-57.4 (54.2±1.8); stylet = 31.5-36.0 (35.0±1.8) um; conus = 16.5-18.0 (17.3±0.75) um; oesophagus = 134-148 (143.0±5.3) um; excretory pore = 100-124 (114.0±8.0) um; tail = 13.5-27.0 (21.5±4.8) um.

Males (n=10) : L = 0.98-1.10 (1.03±0.05) mm; a = 34.3-38.6 (36.6±1.8); b = 8.9-10.0 (9.3±0.44); b' = 6.7-8.0 (7.4±0.45); c = 32.5-40.3 (36.4±2.3); c' = 1.2-1.5 (1.4±0.09); stylet = 31.5-34.5 (32.5±0.96) um; conus = 16.5-18.0 (17.3±0.68) um; oesophagus = 144-186 (163.0±17.6) um; excretory pore = 98-124 (110.0±8.5) um; spicules = 39-42 (33.2±1.6) um; gubernaculum = 18-21 (19.2±0.9) um; bursa = 41-59 (53.0±6.5) um; tail = 26-30 (28.6±1.8) um.

Haflong, Assam population

Females (n=15) : L = 0.98-1.34 (1.12±0.09) mm; a = 33-42 (37.5±3.0); b = 8.9-11.8 (9.9±0.87); b' = 7.3-9.6 (7.8±0.8); c = 51.0-89.5 (65.9±11.0); c' = 0.61-0.87 (0.73±0.11); V = 54.8-59.2 (56.3±1.4); stylet = 33-36 (34.8±1.1) um; conus = 16.5-18.0 (17.2±0.75) um; oesophagus = 140-154 (146.0±5.5) um; excretory pore = 98-122 (106.0±8.0) um; tail = 12-21 (17.4±2.2) um.

Males (n=10) : L = 1.0-1.09 (1.06±0.03) mm; a = 33.9-40.6 (37.8±2.7); b = 8.3-9.8 (9.2±0.54); b' = 6.4-7.4 (7.1±0.43); c = 37.5-39.0 (37.9±0.35); c' = 1.3-1.5 (1.4±0.1); stylet = 33-36 (34.5±0.75) um; conus = 16.5-18.0 (17.3±0.7) um; oesophagus = 144-160 (150.0±6.0) um; excretory pore = 96.5-105.0 (100.0±3.5) um; spicules = 39.0-43.5 (41.6±1.6) um; gubernaculum = 19.5-22.5 (20.6±1.25) um; bursa = 52-66 (59.6±4.2) um; tail = 25.0-28.5 (27.4±0.75) um.

Description :

Female : Body slightly ventrally arcuate upon fixation, narrow at head end. Cuticle transversely striated, striae 2-3 um thick at midbody. Lateral fields withasingle line formed by breaks in striae, originating near spear base. Lip region hemispherical,setoff by deep constriction, 7.5-9.0 um high, 13.5-15.0 um wide with three coarse annules. Labial disc slightly elevated, elongate-ovoid. Oral aperture circular. Amphidial apertures slit-like, behind oral disc. Lip annules longitudinally striated to form six sectors, laterals narrower than

subdorsals and subventrals. Basal lip annule with six longitudinal striae. Cephalic framework strongly sclerotized. Stylet strong, conus 48-52% of stylet length long, basal knobs tulip-shaped, 6-7 um high, 7-8 um wide. Dorsal oesophageal gland opening 4.5 um behind spear base. Oesophagus 143-160 um long. Procorpus cylindrical, 39-48 long. Metacorpus muscular, oval, 15-18 um long, 13.5-15.0 um wide with 7.5 um long valve plates. Isthmus tubular, 7.5-15.0 um long. Nerve ring 86-102 um from anterior end. Basal oesophageal glands overlapping intestine dorso-laterally, oesophago-intestinal junction at 33-43% of basal part, basal glandular part with six gland nuclei. Excretory pore near oesophago-intestinal junction, 95-115 um from anterior end. Hemizonid two to ten annules posterior to excretory pore.

Gonads amphidelphic, outstretched. Oocytes arranged in single row. Epiptygma double. Vulva a transverse slit. Vagina muscular, 13.5-15.0 um deep. Uterus with proximal glandular and distal muscular regions. Spermatheca spherical, 15-18 um in diameter with sperms. Anus pore-like, intestine slightly overlapping rectum. Tail short, hemispherical with 10-18 annules. Scutellum circular, 4.5 um in diameter; anterior scutellum located at 30-40% and posterior scutellum 72-85% of body length.

Male : Similar to females but slightly smaller in length. Spicules strong, arcuate, capitulum rounded. Gubernaculum simple, arcuate, distal region thicker. Bursa striated, enveloping tail. Tail small conoid about one and a half anal body widths long.

Host and localities : Soil around the roots of (i) rose (Rosa sp.)from Aligarh, Uttar Pradesh, (ii) Paddy (Oryza sativa) from Chamoli, Uttar Pradesh, (iii) Paddy (Oryza sativa) from Haflong, Assam.

Remarks : H. indicus is a widely distributed species in India (Khan & Chawla, 1975). Since Sher (1963) described this species from India, many workers (Husain & Rashid, 1969; Khan & Chawla, 1975 and Chawla & Yadav, 1981) have studied variations in the species. Anderson (1983) reported this species from Canada. The measurements and description of the present species agree well with previous descriptions. The variability of longitudinal striae on basal lip annule could not be studied in great detail but the population we studied consistently showed six sectors.

HOPLOLAIMUS CHAMBUS JAIRAJPURI and BAQRI, 1973

(Figs.14 E-G & 16)

Measurements

Females (n=15) : L = 1.39-1.55 (1.46±0.05) mm; a = 34.5-40.7 (37.0±1.9); b = 9.7-11.0 (10.2±0.45); b' = 6.9-8.6 (7.6±0.51); c = 46.5-58.6 (52.9±4.6); c' = 0.69-1.0 (0.86±0.10); V = 54.0-57.7 (55.8±1.3); stylet = 42-45 (43.5±1.2) um; conus = 22-25 (23.4±1.2) um; oesophagus = 180-210 (192.0±10.9) um; excretory pore = 117-145 (133.5±8.5) um; tail = 24.0-31.5 (27.8±2.6) um.

Description

Female : Body slightly ventrally arcuate upon fixation, narrow at head end. Cuticle transversely striated, striae 1.5-2.0 um wide at midbody. Lateral fields with one faint line formed by breaks in transverse annules, originating near spear base. Lip region setoff by deep constriction, hemispherical, 9-10 um high, 16.5-18.0 um wide the three annules. Labial disc somewhat rectangular with rounded corners, not elevated. Oral aperture round, pore-like. Amphidial openings slit-like, behind labial disc. All lip annules longitudinally striated, forming six sectors; laterals narrower than subdorsal and subventrals. Basal lip annule with six longitudinal striae. Cephalic framework strongly sclerotized. Stylet well developed, strong, conus pointed, 53-56% of stylet length. Basal knobs anteriorly indented irregularly, 6.0-7.5 um high, 9.0-10.5 um wide. Dorsal oesophageal gland opening 6.0 um behind spear base. Oesophagus 180-211 um long. Procorpus tubular, 40-52 umm long. Metacorpus oval, 19.5-22.5 um long, 18.0-19.5 um wide with 7.5-9.0 um long valve plates. Isthmus slender, 12.0-22.5 um long encircled by nerve ring. Nerve ring 116-128 um from anterior end.. Basal oesophageal glands overlapping intestine dorso-laterally, containing six gland nuclei. Excretory pore near oesophago-intestinal junction, 117-142 um from anterior endd. Hemizonid six to ten annules posterior to excretory pore.

Gonads amphidelphic, outstretched. Oocytes arranged in two rows. Epiptygma double. Vulva a transverse slit, vagina muscular,

13.5-16.5 um deep. Uterus with proximal glandular and distal muscular regions. Spermatheca reduced, without sperms. Anus pore-like, intestine slightly overlapping rectum. Tail short, hemispheroid with 10-18 coarse annules. Scutellum circular 4-5 um in diameter. Anterior scutellum located at 30-35% and posterior scutellum 75-82% of body length.

Male : Not found.

Host and locality : Soil around roots of banana (Musa paradisiaca) from Haldwani, Uttar Pradesh.

Remarks : H. chambus was first described by Jairajpuri & Baqri (1973) from Chamba district (Himachal Pradesh). H. chambus very closely resembles H. indicus in measurements and SEM morphology, but can be differentiated in the absence of males and a nonfunctional spermatheca. The character of six striae on basal lip annule appears consistent against 6-20 in the Canadian H. indicus population (Anderson, 1983).

ROTYLENCHUS FILIPJEV, 1936

Diagnosis : Female body coiled to C-shaped. Lip region offset or continuous with body, anteriorly rounded or flattened, generally annulated, some times smooth, with or without longitudinal striae on basal lip annule. Lateral fields with four incisures, with or without areolation. Cephalic sclerotization well developed. Stylet knobs with rounded to indented anterior surface. Dorsal oesophageal gland opening 6-16 um behind spear base. Oesophageal glands overlap intestine dorsally and laterally, dorsal gland more developed than subventral glands; intestine symmetrically arranged between the subventral glands. Gonads amphidelphic, outstretched, both branches equally developed, rarely posterior branch degenerated. Epiptygma single or double. Tail short, hemispherical, rarely with small ventral projection. Phasmids pore-like, anterior or posterior to anus. Bursa enveloping tail. Secondary sexual dimorphism not marked, sometimes anterior part of male body slightly smaller than female.

Type species : Rotylenchus robustus (De Man, 1876) Filipjev, 1936

ROTYLENCHUS INDOROBUSTUS JAIRAJPURI & BAQRI, 1973

Measurements

Females (n=10) L = 0.79-1.03 (0.89±0.07) mm; a = 36.2-40.8 (38.7±1.6); b = 5.5-6.8 (6.2±0.5); b' = 4.9-5.9 (5.4±0.52); c = 42-52 (49.0±2.3); c' = 0.52-0.75 (0.67±0.08); V = 55-62 (58.0±2.4); stylet = 30.0-31.5 (30.7±0.75) um; conus = 17.5 um; oesophagus = 170-203

(188.0±14.0) um; excretory pore = 120-138 (130.0±6.2) um; tail = 22.5-28.0 (25.6±2.17) um.

Males : Not found.

Host and locality : Soil around roots of pine tree (Pinus sp.) from Rohtang Pass, Himachal Pradesh.

Remarks : The present specimens closely agree with the original description of Rotylenchus indorobustus Jairajpuri & Baqri, 1973 except for the slightly posteriorly located vulva.

HELICOTYLENCHUS STEINER, 1945

Diagnosis : Body vermiform, medium-sized (0.4-1.2 mm), spiral to straight. Lip region continuous to slightly offset , rounded or truncated, with or without annulation, no longitudinal indentation on annules. Anterior lip annule generally not divided into sectors, with elongate amphidial apertures, rarely faint or marked lip sectors are present. Lateral fields with four incisures. Stylet robust, dorsal oesophageal gland opening one-fourth to half stylet length behind stylet. Oesophageal glands overlap intestine dorsally and ventrally. Gonads amphidelphic, both branches usually equally developed, posterior branch sometimes degenerate or reduced. Epiptygma present. Vulval flaps present, inconspicuous. Phasmids small, near anus; cephalids and caudalids present. Tail short, hemispherical, dorsally convex-conoid, with or without a ventral or terminal projection. Slight secondary sexual dimorphism seen in smaller anterior end of male. Bursa enveloping entire tail, rarely subterminal.

Type species : Helicotylenchus dihystera (Cobb, 1893) Sher, 1961

HELICOTYLENCHUS INCISUS DAREKAR & KHAN, 1978

(Figs.17 A-C & 18 C,D)

Measurements

Females (n=10) : L =0.65-0.93 (0.80±0.09) mm; a = 33.5-44.3 (40.6±3.6); b = 6.3-7.6 (7.3±0.2); b' = 5.6-6.4 (6.2±0.32); c = 39.8-

56.0 (50.8±5.3); c' = 0.91-1.11 (0.99±0.5); V = 59.3-65.0 (62.3±1.8); stylet = 22.5-27.0 (25.2±1.5) um; conus = 12.0 um; oesophagus = 114-156 (130.0±14.5) um; excretory pore = 87-129 (106.0±15.3) um; tail = 15-18 (16.3±1.3) um.

Description

Female : Body closed C-shaped to coiled, narrow at head end. Cuticle finely transversely striated, each striae about 1.5 um apart at midbody. Lateral fields with four incisures, 30-33% of body width wide at midbody, lateral lines smooth, originating near spear base and terminating in posterior third of tail. Lip region continuous, smooth, truncated, 4-5 um high, 7.5-9.0 um wide. Labial disc elevated, circular, with slit-like oral aperture. Amphidial apertures elongate slit-like, behind labial disc. Labial plate fused, circular in shape. Lip annules absent. Cephalic framework strongly sclerotized, basal plate extending posteriorly two to three annules into the body annules. Stylet well developed, conus conoid, 48-53% of stylet length. Basal knobs spherical with cupped anterior surface, 3 um high, 4.5-6.0 um wide. Dorsal oesophageal gland opening 7.5-9.0 um behind spear base. Oesophagus with tubular 36-57 um long procorpus. Metacorpus spherical, 12-15 um in diameter. Isthmus narrow, 12-21 um long. Basal oesophageal glandular part overlapping intestine dorso-ventrally, more on ventral side. Nerve ring at 74-105 um from anterior end. Excretory pore at the base of isthmus. Hemizonid anteriorly adjacent to excretory pore.

Gonads amphidelphic, outstretched. Oocytes arranged in single row. Uterus bipartite, muscular part followed by glandular part. Spermatheca absent. Intestine not overlapping rectum. Anus pore-like. Tail sub-clavate to hemispherical, tip annulated, one anal body width long. Phasmids 12-16 annules anterior to anus.

Male : Not found.

Host and locality : Soil around roots of sugarcane (Saccharum officinarum) from Surat, Gujarat.

Remarks : The present specimens conform closely with the description of H. incisus Darekar & Khan, 1978. Additional SEM observations are provided for the first time.

HELICOTYLENCHUS PARACANALIS SAUER & WINOTO, 1975

Measurements

Females (n=8) : L = 0.66-0.78 (0.73±0.05) mm; a = 31.4-35.3 (33.2±1.6); b = 5.7-6.0 (5.9±0.1); b' = 4.9-5.3 (5.2±0.17); c = 49.5-55.0 (52.3±2.3); c' = 0.66-1.00 (0.87±0.12); V = 56.3-61.0 (58.8±1.9); stylet = 30-33 (31.5±1.22) um; conus = 15-16 (15.3±0.47) um; oesophagus = 134-152 (142.8±6.0) um; excretory pore = 99-108 (103.0±3.5) um; tail = 15-18 (16.5±1.22) um.

Males (n=4) : L = 0.63-0.65 (0.64±0.01) mm; a = 35.2-36.7 (36.0±0.65); b = 5.4-5.5 (5.45±0.03); b' = 4.6 -4.9 (4.7±0.05); c = 35.2-36.6 (36.0±0.63); c' = 1.33-1.50 (1.37±0.07); stylet = 28.5-30.0 (29.5±0.7) um; conus = 13.5-15.0 (14.5±0.7) um; oesophagus = 135-142 (137.0±2.6) um; excretory pore = 102-109 (105.0±4.0) um; spicules = 27.0-28.5 (28.0±0.7) um; gubernaculum = 10.5 um; bursa = 30-36 (33.3±2.5) um; tail=18.0 um.

Host and locality : Soil around roots of eucalyptus tree (Eucalyptus sp.) from Salem, Tamil Nadu.

Remarks : The present specimens conform closely with the description of Helicotylenchus paracanalis given by Sauer & Winoto (1975).

HELICOTYLENCHUS RETUSUS SIDDIQI & BROWN, 1964

(Figs. 17 D-F & 18 A,B)

Measurements

Hyderabad, Andhra Pradesh population

Females (n=15) : L = 0.72-0.85 (0.78±0.04) mm; a = 35.8-40.8 (38.5±2.0); b = 6.0-8.0 (6.9±0.72); b' = 5.1-8.0 (6.2±0.8); c = 51-70 (58.9±6.8); c' = 0.61-0.83 (0.71±0.07); V = 57.8-63.2 (60.5±1.6); stylet = 22.5-25.5 (25.0±0.73) um; conus = 12.0 um; oesophagus = 128-142 (134.0±7.4) um; excretory pore = 93-108 (99.0±5.5) um; tail = 12-15 (13.6±1.2) um.

Kurnool, Andhra Pradesh population

Females (n=10) : L = 0.85-0.90 (0.88±0.02) mm; a = 41-43 (42.0±0.88); b = 7.2-8.6 (7.8±0.47); b' = 5.6-6.6 (6.1±0.34); c = 50-59 (54.0±2.6); c' = 0.90-1.3 (0.98±0.13); V = 55-60 (58.9±1.8); stylet = 24.0-25.5 (24.4±0.64) um; conus = 12.0 um; oesophagus = 135-157 (144.0±7.6) um; excretory pore = 99-106 (104.0±2.6) um; tail = 15-18 (16.6±0.89) um.

Host and localities : Soil around roots of (i) paddy (Oryza sativa) from Hyderabad, Andhra Pradesh, (ii) paddy (Oryza sativa) from Kurnool, Andhra Pradesh.

Remarks : The present specimens closely agree with the description of Helicotylenchus retusus as given by Siddiqi & Brown (1964) and Sher (1966). Additional data revealed by SEM has shown that lip region is faintly annulated with four annules, labial disc round and slightly elevated and vulva is a wide transverse slit occupying more than 75% of body width.

SCUTELLONEMA ANDRASSY, 1958

Diagnosis : Body small to moderately large (0.5-1.3 mm long), spiral to C-shaped or almost straight upon relaxation. Lip region offset or continuous, truncate to rounded, annulated or smooth, with or without indentation of basal annule. First labial annule divided into six sectors, lateral sectors smaller than submedians. Amphidial apertures oval, between labial disc and lateral sectors. Lateral fields with four lines usually areolated near phasmids and anteriorly, sometimes over whole body. Cephalic framework well sclerotized. Stylet strong, knobs round to oval or spherical with irregular anterior surface. Dorsal oesophageal gland opening 4-8 um from spear base. Oesophageal glands overlap intestine dorsally and laterally. Gonads amphidelphic, outstretched, both branches equally developed. Epiptygma present. Tail short, rounded. Phasmids enlarged (scutella) situated opposite each other, near anus level. Bursa enveloping tail tip, usually regular, rarely deeply lobed.

Type species : Scutellonema balberum (Steiner, 1937) Andrassy, 1958

SCUTELLONEMA BREVISTYLATUM SIDDIQI, 1979

(Figs. 19 A-E & 21)

Measurements

Coonoor, Tamil Nadu population

Females (n=10) : L = 0.59-0.75 (0.65±0.05) mm; a = 30.0-34.5 (31.6±1.6); b = 5.3-6.9 (5.9±0.46); b' = 4.5-5.7 (4.9±0.39);

c = 52.5-75.0 (62.1±8.1); c' = 0.57-0.80 (0.67±0.08); V = 59.0-62.5 (60.7±1.5); stylet = 24-26 (25.2±0.52) um; conus = 11-12 (11.5±0.49) um; oesophagus = 129-141 (138.0±4.0) um; excretory pore = 110-120 (116.0±3.5) um; tail = 9-12 (10.7±1.2) um; scutellum diameter (outer) = 3-4 (3.5±0.5) um; scutellum diameter (inner) = 4-5 (4.5±0.5) um.

Tezpur, Assam population

Females (n=10) : L = 0.56-0.64 (0.62±0.02) mm; a = 25.6-35.7 (29.2±2.7); b = 5.6-7.7 (6.6±0.6); b' = 4.9-6.7 (5.7±0.58); c = 46.9-64.3 (54.2±5.4); c' = 0.53-0.66 (0.61±0.04); V = 55.6-62.5 (58.3±2.7); stylet = 22-24 (23.2±0.75) um; conus = 11.0 um; oesophagus = 92-133 (110.0±14.0) um; excretory pore = 87-107 (97.0±6.9) um; tail = 10-12 (11.5±0.78) um; scutellum diameter (outer) = 3-4 (3.4±0.49) um; scutellum diameter (inner) = 4-5 (4.5±0.5) um.

Description

Females : Body a loose spiral upon fixation, narrow at head end. Cuticle transversely striated, each striae 1.5-2.0 um apart at midbody. Lateral fields with four lines, 24-28% of body width wide, areolated in anterior end and scutellar regions, originating near spear base. Lip region setoff, hemispherical, 6 um high, 9.0-10.5 um wide with three annules. Cephalic disc circular, elevated. Amphidial apertures pore-like. All lip annules longitudinally striated, basal lip annule with 10 longitudinal striae. Cephalic framework strongly

sclerotized. Stylet well developed; conus narrow, 45-48% of stylet length. Basal knobs spherical with flat anterior surface, 3 um high, 4-5 um wide. Dorsal oesophageal gland opening 6 um behind spear base. Procorpus tubular, 36-42 um long. Metacorpus muscular, oval 13.5-16.5 um long, 10.0-13.5 um wide with 4.0 um long valve plates. Isthmus narrow, 12-18 um long. Basal glandular part overlapping intestine dorso-laterally. Nerve ring at 80-93 um from anterior end. Excretory pore near base of glandular part of oesophagus. Hemizonid anterior to excretory pore.

Gonads amphidelphic, outstretched. Oocytes arranged in single row. Epiptygma double. Vulva a transverse slit, vagina muscular, 10.5-15.0 um deep. Uterus with muscular and glandular parts. Spermatheca absent. Intestine not overlapping rectum. Anus pore-like. Tail short, conoid, terminus annulated. Scutella round at the level of anus.

Male : Not found.

Host and localities : Soil around roots of (i) tea (Camellia sinensis) from Coonoor, Tamil Nadu, (ii) forest tree (unidentified) from Tezpur, Assam.

Remarks : Scutellonema brevistylatum was described by Siddiqi (1972b) and briefly redescribed by Germani et al. (1985). In the present study S. brevistylatum is redescribed with additional SEM

data. The measurements closely conform to those of Siddiqi (1972b) and Germani et al. (1985), but minor differences occur in body shape and epiptygma (loose spiral shape body and double epiptygma against arcuate to C-shaped body and epiptygma not seen in earlier observations).

SCUTELLONEMA GRANDE SHER, 1964

(Figs. 25 & 26)

Measurements

Females (n=15) : L = 1.03-1.15 (1.09±0.04) mm; a = 34.1-38.3 (36.3±1.5); b = 6.8-8.5 (7.7±0.63); b' = 5.0-7.1 (6.0±0.66); c = 36.8-45.1 (39.7±2.9); c' = 1.0-1.2 (1.1±0.04); V = 53.4-59.0 (56.0±2.5); stylet = 31.5-36.0 (34.5±1.9) um; conus = 13-15 (13.9±0.75) um; oesophagus = 150-217 (184.0±22.1) um; excretory pore = 126-165 (138.0±15.8) um; tail = 25.5-30.0 (27.0±1.4) um; scutellum diameter (outer) = 4.0-4.5 (4.3±0.22) um; scutellum diameter (inner) = 5-6 (5.5±0.5) um.

Males (n=10) : L = 0.95-1.21 (1.04±0.09) mm; a = 31.0-39.7 (35.6±2.8); b = 7.3-8.0 (7.7±0.3); b' = 5.9-7.3 (6.6±0.48); c = 33.6-38.6 (36.2±2.0); c' = 0.98-1.5 (1.3±0.17); stylet = 31.5-36.0 (33.0±1.8) um; conus = 13-14 (13.7±0.82) um; oesophagus = 140-182 (158.6±12.7) um; excretory pore = 110-126 (116.0±5.7) um; spicules = 39-48 (43.0±3.7) um; gubernaculum = 16.5-19.5 (17.4±1.2) um; bursa =

45-54 (50.0±3.2) um; tail = 27.0-31.5 (28.8±1.7) um; scutellum diameter (outer) = 3.0-4.5 (3.6±0.7) um; scutellum diameter (inner) = 4.5-6.0 (5.2±0.7) um.

Description

Female : Body straight to slightly ventrally curved upon fixation, narrow at head end. Cuticle transversely striated, each striae 1.5 um apart at midbody. Lateral fields with four incisures, 25-30% of body width wide, areolated in anterior and scutellar regions, originating near spear base. Lip region continuous, truncated with round margins, 6.0-7.5 um high, 10.5-12.0 um wide with 5-6 annules. Cephalic disc slightly rectangular with round corners, elevated. Oral aperture pore-like. Labial plate six-sectored, squarish, lateral sectors small with pore-like amphidial apertures. Lip annules without longitudinal striations. Cephalic framework strongly sclerotized. Stylet well developed, strong; conus conoid, 57-62% of stylet length. Basal knobs strong, round, with irregular anterior surface, 4.5 um high, 9.0 um wide. Dorsal oesophageal gland opening 3.0-4.5 um behind spear base. Procorpus 40-60 um long; metacorpus oval, 18-21 um long, 15 um wide, muscular with 6.0-7.5 um long valve plates. Isthmus slender, 15-21 um long. Oesophageal glands overlapping intestine dorso-laterally. Nerve ring 105-136 um from anterior end. Excretory pore at about the level of nerve ring. Hemizonid posterior to excretory pore.

Gonads amphidelphic, outstretched. Oocytes arranged in single row. Epiptygma double. Vulva a transverse slit; vagina muscular, 15.0-19.5 um deep. Uterus with proximal glandular and distal muscular parts. Spermatheca spherical, 22.5-28.0 um in diameter. Anus pore-like. Intestine not overlapping rectum. Tail cylindrical, more or less hemispherical with annulated terminus. Scutellum spherical, internally crescent-shaped, located 2-5 annules anterior to anus.

Male : Similar to female. Spicules strongly developed, arcuate, capitulum 5.0-8.0 um long. Gubernaculum arcuate with hooked distal end. Bursa crenate enveloping tail, notched terminally. Tail conoid, tip with 6.0-7.5 um long hyaline part, terminus pointed.

Host and locality : Soil around roots of banana (Musa paradisiaca) from Hyderabad, Andhra Pradesh, India.

Remarks : Scutellonema grande was originally described by Sher (1964). Siddiqi (1972b) made S. mangiferae Khan and Basir, 1965 a junior synonym of S. grande. In 1985 Germani et. al., synonymized S. eclipsi Ganguly & Khan, 1983 with S. grande and provided SEM illustrations in addition to a brief redescription of the species. In the present study the species is redescribed in detail with SEM observations and LM illustrations. Our observations closely conform with both Sher (1964) and Germani et al. (1985).

SCUTELLONEMA BAMBUSAI n.sp.

(Figs.19 F - J & 20)

Measurements

Paratype females (n = 15) : L = 0.55-0.80 (0.64±0.08) mm; a = 26.8-30.5 (28.1±1.3); b = 6.5-8.9 (7.8±0.82); b' = 5.1-6.6 (5.8±0.48); c = 40.1-73.5 (52.8±10.0); c' = 0.53-0.85 (0.63±0.11); V = 50.5-58.3 (54.7±2.9); stylet =22.0-25.5 (23.3±1.7)um; conus = 8.5-10.5 (9.2±0.94) um; oesophagus = 92-123 (109.0±9.3) um; excretory pore = 92-116 (105.7±8.5) um; tail = 10-16 (12.3±2.0)um; scutellum diameter (inner) = 5-6 (5.5±0.49) um; scutellum diameter (outer) = 3 um.

Holotype female : L = 0.65 mm; a = 27.2; b = 8.8; b' = 5.8; c = 40.5; c' = 0.85; V = 57.2; stylet = 22.0 um; conus = 8.5 um; oesophagus = 115.0 um; excretory pore = 96.0 um; tail = 16.4 um; scutellum diameter (inner) =5.0 um; scutellum diameter (outer) =3.0 um.

Description

Female : Body a loose spiral upon fixation, narrow at head end. Cuticle transversely striated, each striae about 1.5 um wide at midbody. Lateral fields with four incisures, 25-30% of body width; areolated in anterior one third and scutellar regions, originating near spear base. Lip region slightly setoff conoid, 5.5-7.0 um high and 9-11 um wide with three annules. Cephalic disc circular, not elevated. Amphidial apertures slit-like, behind cephalic disc. All lip annules longitudinally striated, basal lip

annule with 14-16 longitudinal striae. Cephalic framework strongly sclerotized. Stylet well developed, strong. Conus 38-42% of stylet length. Basal knobs round, slightly indented anteriorly; 4 um high, 5-6 um wide. Dorsal oesophageal gland opening 3-4 um behind spear base. Procorpus 22.0-31.5 um long, metacorpus slightly oval-shaped, 12-15 um long, 10.0-12.5 um wide with 5-6 um long valve plates. Isthmus 10-15 um long. Oesophageal glands overlapping intestine dorso-ventrally, dorsal overlap longer. Nerve ring 63-79 um from anterior end. Excretory pore near base of oesophagus, 92-116 um from anterior end. Hemizonid anterior to excretory pore.

Gonads amphidelphic, outstretched. Oocytes arranged in single row. Epiptygma single, on anterior vulval lip. Vulva a transverse slit, vagina muscular, 10.0-13.5 um deep. Uterus muscular, spermatheca reduced. Anus pore-like. Tail short, hemispheroid with annulated terminus, 10-16 um long. Scutella circular, 4-5 um in diameter, two annules anterior or posterior to anus.

Male : Not found.

Type habitat and locality : Soil around roots of bamboo (Bambusa sp.) from Itanagar, Arunachal Pradesh.

Type material

Holotype : Female on slide Scutellonema bambusai n.sp./1; deposited in the nematode collection of Department of Zoology, Aligarh Muslim University, Aligarh.

Paratypes : Females on slides Scutellonema bambusai n.sp./2-8; deposited in the nematode collection of Department of Zoology, AligarhMuslim University, Aligarh.

Diagnosis and relationship

Scutellonema bambusai n.sp. is characterized by slightly set-off lip region with three annules, basal lip annule with 14-16 striae, stylet 22.0-25.5 um long, stylet knobs slightly indented anteriorly and lateral lines areolated in anterior and scutellar regions and round scutella.

The new species comes close to S. brevistylatum, Siddiqi, 1972; S. unum Sher, 1964; S. magniphasma Sher, 1963; S. shamimi n.sp. and S. cephalodiscus n.sp.in the presence of longitudinal lines on basal lip annule, lateral lines areolated in anterior and scutellar regions and absence of males. However, it differs from S. brevistylatum in shape of lip region, number of longitudinal striae on basal lip annule and shape of stylet knobs (lip region deeply setoff , hemispherical; basal lip annule with 10 striae; stylet knobs anteriorly flat in S. brevistylatum). It differs from S. unum in shape of lip region, number of lip annules and longitudinal striae on basal lip annule, shape of stylet knobs and tail (lip region sub-conical lip annules 4-6; basal lip annule with 15-22 longitudinal striae, stylet knobs anteriorly flat and tail round, sub conical in S. unum). It differs from S. magniphasma in the shape of lip region and longitudinal striae on basal lip

annule; size of stylet and shape of basal knobs and tail (lip region slightly to deeply setoff, basal lip annule with 20-26 striae, stylet 31-38 um long, stylet knobs anteriorly flat and tail subconical in S. magniphasma). It differs from S. cephalodiscus n.sp. in the absence of elevated cephalic disc, number of striae on basal lip annule and shape of scutella (cephalic disc elevated, basal lip annule with eight striae and scutella crescent-shaped in S. cephalodiscus n.sp.). It differs from S. shamimi n.sp. in number of striae on basal lip annule, intestine not overlapping rectum and shape of scutella (basal lip annule with 10 striae, intestine overlapping rectum and scutella crescent-shaped in S. shamimi n.sp.).

SCUTELLONEMA CEPHALODISCUS n.sp.
(Figs. 22 A - E & 23)

Measurements

Paratype females (n = 10) : L = 0.58-0.85 (0.65±0.02)mm; a = 22.6-32.3 (28.5±2.9); b = 6.4-9.4 (8.4±0.86); b' = 5.5-7.3 (6.2±0.65); c = 41.4-62.0 (49.6±8.6); c' = 0.55-0.73 (0.67±0.06); V = 51.8-60.5 (55.9±2.9); stylet = 21-27 (22.8±1.7) um; conus = 10-12 (11.0±0.81) um; oesophagus = 95-118 (104.5±8.0) um; excretory pore = 88.5-99.0 (94.8±4.0) um; tail = 12-15 (13.5±0.58) um; scutellum diameter (outer) = 3.0-4.5 (3.7±0.75) um; scutellum diameter (inner) = 6.0-7.5 (6.6±0.75) um.

Holotype female : L = 0.59 mm; a = 27.5; b = 6.6; b'= 5.6; c = 43.5; c'= 0.71; V = 57.7; stylet = 22.5 um; conus = 11.0 um;

oesophagus = 107um; excretory pore = 93 um; tail = 13.5 um; scutellum diameter (outer)= 3 um; scutellum diameter (inner) = 6 um.

Description :

Female : Body a loose spiral upon fixation, narrow at head end. Cuticle transversely striated, each striae about 1.5 um wide at midbody. Lateral fields with four incisures, 22-28% of body width wide, areolated in anterior and scutellar regions, originating near spear base. Lip region continuous, conoid, 4.5-6.0 um high, 7.5-10.5 um wide with three annules. Cephalic disc circular, elevated, oral aperture slit-like. Amphidial apertures pore-like, located on lateral sectors of labial plate beside the cephalic disc. All lip annules longitudinally striated, basal lip annule with eight longitudinal striae. Cephalic framework strongly sclerotized. Stylet well developed, conus 44-47% of stylet length. Basal knobs round with irregular anterior surface, 3 um high, 4-5 um wide. Dorsal oesophageal gland opening, 4 um behind spear base. Procorpus slender, 20-28 um long, Metacorpus more or less spherical, 12-15 um in diameter with 4-5 um long valve plates. Isthmus narrow, 12.0-13.5 um long. Oesophageal glands overlapping intestine dorsally and laterally. Nerve ring 66-78 um from anterior end. Excretory pore near base of oesophagus. Hemizonid anterior to excretory pore.

Gonads amphidelphic, outstretched. Oocytes arranged in single row. Epiptygma double. Vulva a transverse slit; vagina

muscular, 9.0-10.5 um deep. Uterus with muscular and glandular regions. Spermatheca reduced. Tail short, hemispheroid to slightly conoid with annulated terminus. Scutella crescent-shaped, two annules posterior to or at the level of anus.

Male : Not found

Type habitat and locality : Soil around roots of cotton (Gossypium hirsutum) from Udna (Surat) Gujarat.

Type material

Holotype : Female on slide Scutellonema cephalodiscus n.sp/1; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Paratypes : Females on slides Scutellonema cephalodiscus n.sp/2-10; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Diagnosis and relationship :

Scutellonema cephalodiscus n.sp. is characterized by a medium-sized body; a continuous lip region with three annules, elevated cephalic disc, basal lip annule with eight striae; stylet knobs with irregular anterior surface; lateral fields areolated in anterior and scutellar regions; scutella crescent-shaped and tail hemispherical to slightly conoid.

The new species comes close to S. brachyurus (Steiner, 1938) Andrassy, 1958; S. brevistylatum Siddiqi, 1972; S. shamimi n.sp. and S. bambusai n.sp. in the absence of males, lateral

fields areolated at scutellar region and striated basal lip annule. However, it differs from all other species in having 8 longitudinal striae on basal lip annule. It further differs from S. brachyurus in shape of lip region and stylet knobs and absence of intestinal overlap on rectum (lip region hemispherical, slightly setoff, basal lip annule with six striae and stylet knobs anteriorly flat and intestine overlapping rectum in S. brachyurus). It also differs from S. brevistylatum in shape of lip region, stylet knobs and scutellum (lip region deeply setoff, basal lip annule with 10 striae, stylet knobs anteriorly flat and scutellum round in S. brevistylatum). It differs from S. bambusai n.sp. in having elevated cephalic disc and shape of scutellum (cephalic disc not elevated, basal lip annule with 14-16 striae and scutellum round in S. bambusai n.sp.). It differs from S. shamimi n.sp. in having elevated cephalic disc (cephalic disc not distinctly elevated and basal lip annule with 10 striae in S. shamimi n.sp.).

SCUTELLONEMA SHAMIMI n.sp.

(Figs. 22 F - J & 24)

Measurements

Paratype females (n = 15) : L = 0.66-0.77 (0.69±0.03)mm; a = 27.6-31.7 (29.4±1.3); b = 7.3 - 9.4 (8.2±0.6); b'= 6.3-7.5 (6.5±0.27) ; c = 55.2-68.5 (61.9±3.9); c' = 0.50-0.66 (0.55±0.04); V = 54.1-58.8 (56.7±1.6); stylet = 22.5-25.5 (24.0±0.7) um, conus = 10.5-12.0 (11.0±0.72) um; oesophagus = 100-114 (106.2±3.9) um; excretory pore = 96-104 (99.6±3.2) um; tail = 10.5-13.5

(11.3±0.74) um; scutellum diameter (outer) = 4.0-4.5 (4.2±0.24)um; scutellum diameter (inner) = 6.0-7.5 (6.7±0.75) um.

Holotype female : L = 0.71 mm; a = 31.7; b= 7.7; b'=6.3; c = 59.5; c' = 0.57; V= 56.0; stylet = 24.0 um; conus = 10.5 um; oesophagus = 114.0 um; excretory pore = 104.0 um; tail = 12.0 um; scutellum diameter (outer) = 4.5 um; scutellum diameter (inner) = 7.5 um.

Description

Female : Body closed C-shaped to loose spiral upon fixation , narrow at head end. Cuticle transversely striated, each striae about 1.5 um apart at midbody. Lateral fields with four incisures, 25-30% of body width wide, areolated in anterior and scutellar regions, originating near spear base. Lip region not setoff, conoid, with 3 annules, 4-5 um high, 9.0-10.5 um wide. Cephalic disc oval, not elevated. Amphidial apertures pore-like. Lip annules longitudinally striated, basal lip annule with 10 longitudinal striations. Cephalic framework strongly sclerotized. Stylet well developed, conus 45-50% of stylet length. Basal knobs spherical with indented anterior surface, 3 um high, 5-6 um wide. Dorsal oesophageal gland opening 4.5 um behind spear base. Procorpus tubular, 24-32 um long. Metacorpus more or less spherical,12-15 um in diameter with 5-6 um long valve plates. Isthmus narrow, 12-21 um long. Oesophageal glands overlapping intestine dorsally and laterally. Nerve ring 68-78 um from anterior end. Excretory pore near the base of oesophagus, visible only in few specimens. Hemizonid anterior to excretory pore.

Gonads amphidelphic, outstretched. Oocytes arranged in single row. Epiptygma double. Vulva a transverse slit about 10 um wide, vagina muscular 9-12 um deep. Uterus with muscular and glandular regions. Spermatheca absent. Anus pore-like. Intestine slightly overlapping rectum. Tail short, hemispherical, terminus annulated. Scutella crescent-shaped located near the level of anus.

Male : Not found.

Type habitat & locality : Soil around roots of forest tree (unidentified) from Haflong, Assam.

Type material

Holotype : Female on slide Scutellonema shamimi n.sp/1; deposited in the nematode collection of Department of Zoology, Aligarh Muslim University, Aligarh.

Paratypes : Females on slides Scutellonema shamimi n.sp/2-7; deposited in the nematode collection of Department of Zoology, Aligarh Muslim University, Aligarh.

Diagnosis and relationship :

Scutellonema shamimi n.sp. is characterized by a medium-sized body, non offset lip region with three annules; basal lip annule with 10 longitudinal striae; stylet knobs spherical with slight anterior projections; lateral fields areolated in anterior and scutellar regions, double epiptygma; crescent-shaped scutella and hemispherical tail.

The new species comes close to S.brevistylatum Siddiqi, 1972; S. magniphasma Sher, 1963; S. unum Sher, 1964; S. bambusai n.sp. and S. cephalodiscus n.sp. in the absence of males, lateral fields with areolation at the level of scutellum, and basal lip annule with striae. However, it differs from S. brevistylatum in shape of lip region, basal knobs, tail and scutellum; and intestine overlapping rectum (lip region broadly rounded, deeply offset; basal knobs spherical with flat anterior surfaces; intestine not overlapping rectum, tail conoid and scutellum spherical in S. brevistylatum). It differs from S. magniphasma in shape of lip region, absence of prominently elevated cephalic disc, shape of stylet knobs and tail; intestine overlapping rectum and shape of scutellum (lip region hemispherical, slightly to deeply offset; cephalic disc elevated; basal lip annule with 20-26 striae; stylet knobs with flat anterior surfaces, intestine not overlapping rectum, tail subconical and scutella spherical in S. magniphasma). It differs from S. unum in shape of lip region, number of annules on head, nature of cephalic disc, number of basal lip annule striae and shape of stylet knobs and scutella (lip region subconical, slightly setoff; cephalic disc elevated, basal lip annule with 15-22 striae and stylet knobs with flat anterior surfaces in S. unum). It differs from S. bambusai n.sp. in number of striae on basal lip annule, intestine overlapping rectum and shape of scutellum (basal lip annule with 14-15 striae, intestine not overlapping rectum and scutella round in S. bambusai n.sp.). It differs from S. cephalodiscus n.sp. in the absence of

elevated cephalic disc, number of striae on basal lip annule and intestine overlapping rectum (cephalic disc elevated, basal lip annule with eight striae and intestine not overlapping rectum in S. cephalodiscus n.sp.).

SUPERFAMILY **CRICONEMATOIDEA** TAYLOR,1936

Diagnosis : (Modified after Raski & Luc,1987) Females cylindrical, sausage - shaped or spheroid. Females and juveniles with thick cuticle marked with retrorse or smooth annules, without lateral fields; or provided with spines, scales or extracuticular sheath. Lip region poorly developed, represented by labial disc and four submedian lobes. Oesophagus with pro and metacorpus amalgamated, basal oesophageal bulb pyriform and clearly offset from intestine, exceptionally overlapping intestine. Females with monoprodelphic ovary, post-uterine extension absent. Sexual dimorphism distinct. Males slender with degenerate feeding apparatus and oesophagus; monorchic. Spicules variously shaped and setaceous, bursa rarely present. Phasmids absent and deirids mostly absent. Tail variable from long filiform to rounded.

Type family: Criconematidae Taylor, 1936

Other family: Tylenchulidae Skarbilovich, 1947

FAMILY **CRICONEMATIDAE** TAYLOR,1936

Diagnosis : All stages vermiform, body sausage-shaped to cylindrical. Cuticle thick, lacking typical lateral fields (sometimes marked by anastomoses of annules and superficial longitudinal lines very variable within the same species). Body annules either retrorse, with or without lobation, crenation, scales or spines, rounded or with an extracuticular layer. Labial area variously shaped, submedian lobes absent or variously developed. Labial sclerotization strong. Stylet massive, conus much longer than

shaft plus knobs, stylet knobs anchor-shaped or sloping backwards. Isthmus very short, basal bulb markedly reduced. Males with degenerated stylet, spicules variously shaped, bursa absent to well developed. Juveniles cuticle showing range of variations in cuticlar ornamentation as in females.

Type subfamily : Criconematinae Taylor,1936

Other subfamily : Hemicycliophorinae Skarbilovich,1959

SUBFAMILY **CRICONEMATINAE** TAYLOR, 1936

Diagnosis : Small, stout nematodes, less than 1 mm long, annulation strongly developed with smooth or slightly crenate cuticle or various scale/spine-like projections. Posterior margin of annules ruffled or with platelet-like extracuticular covering or with film-like separate cuticle of various lengths and configurations. Lateral fields absent or with an irregular line formed by anastomosing annuli. Lip region with or without submedian lobes, sclerotized in female, continuous or variously separated from body annules. Stylet massive, cone much longer than shaft plus knobs. Males degenerate, lacking stylet, oesophagus rudimentary; finely annulated, lateral fields with two to four lines. Bursa weakly developed or absent. Juveniles with smooth or slightly crenate annules or elaborate ornamentation present in longitudinal rows of scales or spines.

Type genus : Criconema Hofmanner & Menzel, 1914

Other genera : Ogma Southern,1914

Criconemella De Grisse & Loof,1965
Discocriconemella De Grisse & Loof,1965
Nothocriconemoides Maas, Loof & De Grisse,1971
Bakernema Wu, 1964
Blandicephalanema Mehta & Raski, 1971
Pateracephalanema Mehta & Raski, 1971
Hemicriconemoides Chitwood & Birchfield, 1957

CRICONEMA HOFMANNER & MENZEL, 1914

Diagnosis : Female body 0.24-0.74 mm long. Body annules 24-134; finely crenate, smooth or variously ornamented: if scale-like, present only on posterior part of body or irregular plate-like coverings on cuticle over entire body or on part of annuli; ruffled, ribbon-like ornamentation surrounding annules on anterior surface or both anterior and posterior surfaces; or cuticular fringe on posterior margin of annules. Annules of lip region smooth; usually with one annule wider and clearly setoff from succeeding body annules; often separation is not distinct and labial region appears to bear two annules. Lip region usually with six pseudolips, rounded and projecting forward from first annule. Stylet 40-132 um long. Vulva on 4th - 21st annulus from tail end, slit-like or completely closed by over-hanging anterior lip. Tail conoid-pointed to bluntly rounded. Male with two to four lateral lines; bursa small, reduced or absent. Juveniles with scale-like cuticular appendages over entire body, usually with refractive elements or spine-like extensions at distal ends, arranged in eight to twentyfour longitudinal rows.

Type species: Criconema giardi (Certes,1889)Micoletzky,1925

CRICONEMA ABERRANS (JAIRAJPURI & A.H.SIDDIQI, 1963) RASKI & LUC, 1987

(Figs. 27 A-C; 28 A-D)

Measurements

Females (n = 15) : L = 480-560 (530±30) um; a = 8.9 -11.1 (10.3±0.7); b = 3.9-4.5 (4.3±0.2); c= ? ; V = 92.8-94.5 (93.5±0.5); stylet = 69.0 - 79.5 (75.0±2.9) um; conus = 52.5-61.5 (57.5±2.4)um; tail = ?; R = 41-45; Rst = 7-9; Roes = 10-13; Rex = ?; Rv = 4-5; Rvan = ?; Ran = ?; VL/VB = 0.8-1.2 (1.0±0.09); St%L = 13.1 - 15.9 (14.1±0.9).

Description

Female : Body robust, straight to slightly ventrally curved upon fixation, narrowing from stylet base to head and posterior to vulva. Body annules coarse, retrorse, 12 - 15 um apart at midbody, anastomoses present. Scales slender, cone-like, longitudinally arranged on anterior surface of annules, margins irregular. Annules on posterior region of body with spine-like projections. Lip region distinctly setoff, 9 - 12 um high with two annules. Labial annule saucer-shaped, 24 - 27 um wide, with smooth margins, wider than second lip annule (the depression on lip annule is probably a fixation artifact). Pseudolips protruding beyond labial margin, four prominent submedian lobes present. Second lip annule 19.5-21.0 um wide, collar-like. Cephalic framework weakly develped. First body annule 24.0-25.5 um wide. Stylet strong, metenchium 74-77% of stylet length, telenchium 18.0-19.5 um long. Basal knobs massive,

anchor-shaped, 4.5 um high, 10.5-12.0 um wide. Dorsal oesophageal gland opening 4.5-6.0 um behind spear base. Oesophagus 114 - 127 um long. Pro-metacorpus muscular, 98 - 105 um long with 9.0-10.5 um long valve plates. Isthmus tubular, 6.0-7.5 um long. Basal bulb saccate, 13.5-15.0 um long, 9.0-10.5 um wide. Nerve ring at 99 - 111 um from anterior end. Excretory pore and hemizonid not visible.

Reproductive system monoprodelphic. Oocytes arranged in double row at tip and single row at posterior end. Vulva a transverse slit, located on 4th or 5th annule from posterior end, vagina anteriorly directed, uterus long, muscular. Spermatheca absent. Anus not visible. Post-vulval region about one vulval body width long. Tail terminus bluntly rounded.

Male : Not found.

Host and locality : Soil around roots of almonds (Prunus amygdalus) from Saharanpur, Uttar Pradesh, India.

Remarks : Criconema aberrans was first described by Jairajpuri & Siddiqi (1963a) as Criconemoides aberrans. The SEM of the species which is done for the first time confirms the presence of sub median lobes on the lip region as described by Jairajpuri & Siddiqi. In addition,it was observed that the cuticle has slender cone-like scales arranged longitudinally on anterior surface of annules.

CRICONEMA RETROLABIATA n.sp.

(Figs.30 & 31)

Measurements:

Paratype females (n = 10) : L = 300 - 350 (320 ± 18) um; a = 8.0-9.7 (8.9 ± 0.62); b = 3.3 - 3.9 (3.6 ± 0.18); c = ? ; V = 90.3-92.5 (91.6 ± 0.73); stylet = 46-54 (52 ± 2.3) um; conus = 39-42 (40.2±1.2) um; tail = ?; R = 52-68; Rst = 10-11; Roes = 15-18; Rex = ? ; Rv = 6-8; Rvan = ? ; Ran = ? ; VL/VB = 0.90 - 0.95 (0.92 ± 0.01) ; St%L = 14.7 - 17.0 (15.8 ± 0.86).

Holotype female : L = 0.31 mm; a = 8.7; b = 3.6; c = ?; V = 91.4 stylet = 52.5 um; conus = 40.5 um; tail = ? ; R = 65; Rst = 11; Roes = 19; Rex = ? ; Rv = 8; Rvan = ? ; Ran = ? ; VL/VB = 0.90; St%L = 16.6.

Description

Female : Body robust, slightly ventrally curved upon fixation, tapering slightly towards extremities. Body annules coarse, retrose, 6.0-7.5 um apart at midbody, Anastomoses of annules absent, margins smooth. Lip region distinctly setoff ,4-5 um high and 18-21 um wide. Labial region elevated, dome-shaped. Lip annule smooth, posteriorly directed, pseudolips protruding. Oral disc circular, submedian lobes present. Amphidial apertures inconspicuous. First body annule 22.5 - 24.0 um or wider than lip annule. Stylet strong, metenchium 77-84% of stylet length, telenchium 12 um long. Basal knobs massive, anchor-shaped, 4 um high, 9 um wide. Dorsal oesophageal gland opening 4-6 um from spear base. Oesophagus

83-93 um long. Pro-metacorpus muscular, 66-72 um long with 8-10 um long valve plates. Isthmus narrow, 4.5-6.0 um long. Basal bulb saccate, 13.5-16.5 um long, 10.5 um wide. Nerve ring at 69-78 um from anterior end. Excretory pore inconspicuous. Hemizonid 5-6 um wide, 110-130 um from anterior end.

Reproductive system monoprodelphic. Oocytes arranged in double row at tip and posteriorly in single row. Vulva a transverse slit, located on 6th to 8th annule from posterior end. Anterior vulval lip flap-like with a cleft in centre. Vagina anteriorly directed. Uterus muscular. Spermatheca spherical, 15-18 um in diameter. Anus not visible, post-vulval region less than one vulval body width long. Tail conoid, terminus blunt.

Male : Not found.

Type habitat and locality : Soil around roots of tea (Camellia sinensis) from Kaziranga, Assam.

Type material

Holotype : Female on slide Criconema retrolabiata n.sp/1; deposited in the nematode collection of Department of Zoology, Aligarh Muslim University, Aligarh.

Paratypes : Females on slides Criconema retrolabiata n.sp/2-10; deposited in the nematode collection of Department of Zoology, Aligarh Muslim University, Aligarh.

Diagnosis and relationship

Criconema retrolabiata n.sp. is characterized by a set-off lip region, a single saucer-shaped lip annule with margins directed posteriorly; first body annule wider than lip annule, labial region with distinct pseudolips and submedian lobes, margin of annules smooth, stylet 46-54 um long; anterior vulval lip with a cleft and body annules less than 70.

Criconema retrolabiata n.sp. comes close to C. talanum (Van den Berg, 1984) Raski & Luc, 1987, C. sulcitum (Van den Berg, 1984) Raski & Luc,1987 and C. lantanum (Van den Berg,1984) Raski & Luc, 1987 in having a lip annule with smooth margins, a protruding labial region with pseudolips, absence of anastomoses, position of vulva and tail shape. However, it differs from the closely related species C.talanum in having a saucer-shaped lip annule with margins directed posteriorly, first body annule wider than lip annule, body annules retrorse, anterior vulval lip with cleft and total body annules less than 70 (lip annule directed anteriorly, first body annule narrower than lip annule; body annules not retrorse except on tail, vulval lips smooth and R = 70-77 in C. talanum). From C. sulcitum it differs in having the margin of lip annule directed posteriorly, smaller stylet, anterior vulval lip with cleft, lesser number of body annules and fewer post-vulval annules (lip annule anteriorly directed, stylet 62-70 um long, vulval lips smooth, R = 77-83 and Rv = 9-10 in C. sulcitum). It can be differentiated from C. lantanum by a smaller body, absence of fine

longitudinal ridges on body annules, smaller stylet and larger number of body annules (L = 0.41 - 0.53 mm, fine longitudinal ridges present on body annules, stylet 90.5 - 96.3 um long and R = 42 - 45 in C. lantanum).

OGMA SOUTHERN, 1914

Diagnosis : Female body 0.27-0.86 mm long. Body annules 44-90 with various cuticular ornamentations over the entire body (simple scales or rounded or pointed appendages arranged in 8-18 longitudinal rows); each annule bearing eight palmate lobes with spines on adjacent rows or single spines may appear scattered on annule; scales or spines may be arranged in 9-20 (rarely 27) longitudinal lines, may be bi- or multi-lobed (two to seven at tip); or with continuous fringe of scales or spines; bluntly rounded or unipointed spines not arranged in rows, 24-90 in number on each annule at midbody. Head annules two (exceptionally one) well setoff from body and with or without ornamentation; first lip annule usually wider than second but may be of equal width; submedian lobes absent or if present not well developed. Stylet 48-130 um long. Vulva closed or open, located on 3rd-19th annule from posterior end, anterior vulval lip rarely larger than posterior one. Tail conoid, pointed to bluntly rounded. Male with three or four lines in lateral field; bursa rudimentary or absent. Juveniles with scales in 8-18 longitudinal rows or rarely alternating with adjacent annuli.

Type species : Ogma murrayi Southern, 1914

OGMA CIVELLAE (STEINER, 1949) RASKI & LUC, 1987

(Figs. 27 D-F; 28 E-G & 29)

Measurements

Chamoli, Uttar Pradesh population

Females (n=10) : L = 363-522 (440±62) um; a = 6.4-8.4 (7.4±0.61);

b = 3.0-4.6 (3.8±0.66); c = 6.4-9.6 (8.2±1.4); c' = 1.0-1.5 (1.2±0.81); V = 80.8-88.0 (84.4±2.7); stylet = 78-87 (82.0±3.4) um; conus = 63.0-70.5 (67.0±2.5) um; tail = 48-63 (54.0±5.2) um; R = 44-54; Rst = 9-10; Roes = 12-14; Rex = ?; Rv = 9-13; Rvan = 2-3; Ran = 7-10; VL/VB = 0.9-1.26 (1.12±0.14); St%L = 16.4-21.3 (18.2±1.8).

Nainital, Uttar Pradesh population

Females (n=12) : L = 420-520 (480±30) um; a = 10.2-11.5 (10.9±0.5); b = 3.4-3.9 (3.6±0.16); c = ?; c' = ?; V = 89.5-92.0 (90.5±0.9); stylet = 82.5-91.5 (85.8±3.2) um; conus = 66-72 (68.7±2.4) um; tail = ?; R = 41-46; Rst = 7-8; Roes = 11-13; Rex = ?; Rv = 5-6; Rvan = ?; Ran = ?; VL/VB = 1.09-1.33 (1.21±0.09); St%L = 16.8-19.2 (17.8±0.96).

Description

Female : Body robust, straight to slightly ventrally curved upon fixation, narrowing from stylet base to lip region and from vulva to tail tip. Annules coarse, retrorse, 13.5-15.0 um apart at midbody, anastomoses present. Margins of annules with a continuous fringe of 70-90 blunt tipped or inverted 'Y'- shaped spines, spines elongated, extending to succeeding annules. Lip region distinctly setoff with two annules. Labial annule saucer-shaped, 27-33 um wide, margin with spines. Pseudolips protruding beyond lip annule, submedian lobes poorly developed. Amphidial apertures slit-like. Oral aperture 'I'-

shaped; second lip annule narrower than first, 21-24 um wide, outwardly or posteriorly directed with spines on margin. Cephalic sclerotization weak. First body annule 32.5-40.5 um wide, retrorse. Stylet strong; metenchium tubular, narrow at tip, 78-82% of stylet length; telenchium 13-19 um long. Basal knobs anchor-shaped, 3-4 um high, 10.5-12.0 um wide. Dorsal oesophageal gland opening 4.5-6.0 um behind spear base. Oesophagus 120-140 um long. Pro-metacorpus muscular, 100-112 um long with 9.0-10.5 um long valve plates. Isthmus narrow, 7.5-9.0 um long. Basal bulb saccate, 10.5-12.0 um long, 7.5 um wide. Nerve ring at 106-118 um from anterior end. Excretory pore and hemizonid not visible.

Reproductive system monoprodelphic. Oocytes arranged in a single row. Vulva a transverse slit, located on 5th to 13th annule from posterior end. Vagina anteriorly directed, 12-15 um long. Uterus elongated, muscular. Spermatheca absent. Anus on 7-10 annule from posterior end (visible in one population only). Post-vulval region about one vulval body width long. Tail terminus bluntly rounded.

Male : Not found.

Host and localities : Soil around the roots of (i) apricot (Prunus armeniaca) from Chamoli, Uttar Pradesh, (ii) sweetpea (Pisum sativum) from Nainital, Uttar Pradesh.

Remarks : The present specimens generally agree with the measurements and description of Ogma civellae given by Mehta &

Raski (1971). However, some variations were observed in both the populations. Specimens from Chamoli were more robust with an anteriorly located vulva, Rv = 9-13, anus distinct and palmate spines on the tail. The Nainital population consisted of comparatively slender specimens with an indistinct anus, posteriorly located vulva and simple elongated spines on tail. The Chamoli population showed a greater resemblance to the description of Mehta & Raski (1971) than the Nainital population.

CRICONEMELLA DE GRISSE & LOOF, 1965

Diagnosis : (Modified after Luc & Raski, 1981). Female body varies from 0.20-1.00 mm in length. Annules 42-200; posterior edge smooth or finely crenate. Head with submedian lobes generally well developed, may be poorly developed or absent in some species; submedian lobes separated or connected in different ways; first annule may be reduced or divided into plates; in some species first annules not retrorse but forwardly directed. Vulva closed or open, anterior lip of vulva may be ornamented. Spear well developed, rarely thin and flexible, sometimes short with rounded basal knobs. Male head end rounded to conoid; lateral lines generally four, rarely three, exceptionally two; bursa distinct, exceptionally absent. In juveniles annules smooth to crenate and without scales.

Type species : Criconemella parva (Raski, 1952) De Grisse & Loof, 1965

CRICONEMELLA MEDANI (PHUKAN & SANWAL, 1980) LUC & RASKI, 1981

Measurements

Females (n=15) : L = 420-540 (460±30) um; a = 10.5-11.9 (11.3±0.66); b = 4.5-5.5 (4.8±0.3); c = 13-16 (14.5±1.2); V = 91.5-92.8 (92.2±0.43); stylet = 42.0-46.8 (44.8±1.5) um; conus = 38.5-41.5 (40.6±1.1) um; tail = 25.5-36.0 (32.0±2.9) um; R = 123-145; Rst = 15-16; Roes = 28-32; Rex = 29-34; Rv = 8-9; Rvan = 2; Ran = 6-7; VL/VB = 1.0-1.2 (1.1±0.06); St%L = 8.3-11.0 (9.8±0.94).

Males : Not found.

Host and locality : Soil around the roots of grasses (unidentified) from Cherapunji, Assam.

Remarks : Criconemella medani was first described by Phukan & Sanwal (1980b). The present specimens closely agree with the original description except for the frequent anastomoses on body annules.

CRICONEMELLA CHAMOLII n.sp.

(Figs. 32 & 33)

Measurements

Paratype females (n=8) : L = 380-440 (400±20) um; a = 8.8-9.9 (1.4±0.4); b = 3.6-4.5 (4.2±0.38); c = 12.2-16.0 (14.2±1.3); V = 85.3-88.5 (87.7±1.1); stylet = 64.5-75.0 (68.0±3.5) um; conus = 54-61 (56.7±2.9) um; tail = 25.5-36.0 (28.5±3.6) um; R = 54-65; Rst = 11-13; Roes = 17-18; Rex = 20-21; Rv = 8-10; Rvan = 2; Ran = 5-7; VL/VB = 1.5-2.0 (1.7±0.16); St%L = 16.4-17.4 (16.8±0.27).

Holotype female : L = 410 um; a = 9.7; b = 4.5; c = 16.0; V = 85.4; stylet = 69.0 um; conus = 55.5 um; tail = 25.5 um; R = 58; Rst = 12; Roes = 17; Rex = 20; Rv = 8; Rvan = 2; Ran = 5; VL/VB = 2.0; St%L = 16.8.

Description

Female : Body arcuate upon fixation, tapering towards extremities, terminating posteriorly in an acutely conoid tail. Body annules coarse,

retrorse, 7.5-9.0 um apart at midbody. Annules with ornamentation as shown in figure; few annules on tail without ornamentation. Anastomoses frequently present on annules, sometimes even on lip annules. Lip region 6.0-7.5 um high with three annules. First lip annule divided into four labial plates. Labial disc oval-shaped, protruded, with a central slit-like oral aperture. Amphidial apertures slit-like, located on edge of labial disc. Submedian lobes absent. Second and third annules wider than first lip annule but slightly smaller than first body annule. First body annule 25.5-27.0 um wide. Stylet strong, metenchium 80-83% of stylet length, telenchium 13.5-15.0 um long. Basal knobs robust, anchor-shaped, 3 um high, 7.5-9.0 um wide. Dorsal oesophageal gland opening 4.5-7.5 um behind spear base. Oesophagus 106-120 um long. Pro-metacorpus muscular, 81-89 um long, 18.0-19.6 um wide with 7.5-9.0 um long valve plates. Isthmus narrow, 4.5-6.0 um long. Basal bulb saccate, 18.0-19.5 um long, 9.0-10.6 um wide. Nerve ring 84-102 um from anterior end. Excretory pore 130-142 um from anterior end. Hemizonid indistinct.

Reproductive system monoprodelphic. Oocytes arranged in two rows at tip and single row at posterior end. Vulva a transverse slit, anterior vulval lip flap-like. Vagina anteriorly directed. Uterus muscular, spermatheca absent. Anus on 6th to 8th annule from posterior end, located less than half vulval body width from vulva. Tail acutely conoid, terminus pointed with smooth tip.

Male : Not found.

Type habitat and locality : Soil around the roots of orange tree (Citrus sinensis) from Chamoli, Uttar Pradesh.

Type material

Holotype : Female on slide Criconemella chamolii n.sp./1; deposited in the nematode collection of Department of Zoology, Aligarh Muslim University, Aligarh.

Paratypes : Females on slides Criconemella chamolii n.sp./2-8; deposited in nematode collection of Department of Zoology, Aligarh Muslim University, Aligarh.

Diagnosis and relationship

Criconemella chamolii n.sp. is characterized by a continuous lip region with three lip annules; first lip annule divided into four labial plates; labial disc protruded, ovoid with slit-like oral and amphidial apertures; submedian lobes absent; body annules with ornamentation, stylet 65.5-75.0 um long, vulva with a flap, tail acutely conoid, R = 54-65, Rv = 8-10 and Rvan = 2.

The new species comes close to C. annulatiformis (De Grisse & Loof, 1967) Luc & Raski, 1981; C. reedi (Diab & Jenkins, 1966) Luc & Raski, 1981; C. goodeyi (De Guiran, 1963) Luc & Raski, 1981; C. kirjanovae (Andrassy, 1962) Luc & Raski, 1981; C. lamottei (Luc, 1970) Luc & Raski, 1981 and C. yapoensis (Luc, 1970) Luc & Raski, 1981 in having a sharply pointed tail and C. rosmarini

Castillo, Siddiqi & Barcina, 1988 in the absence of submedian lobes and presence of prominent ornamentation on the cuticle. The new species differs from all the species in the type of cuticular ornamentation. Further it differs from C. annulatiformis, C. reedi, C. goodeyi and C. kirjanovae in having fewer body annules and absence of submedian lobes (R = 54-65 vs more than 75, submedian lobes absent vs present in the four species). From C. lamottei it differs in having fewer body annules and longer stylet (R = 76-98 and stylet = 39-45 um in C. lamottei). It differs from C. yapoensis in having longer body, longer stylet, anteriorly located vulva and frequent anastomoses (L = 250-350 um, stylet = 50-56 um long, V = 91-96 and anastomoses absent in C. yapoensis). It also differs from C. rosmarini in the number of body annules and tail shape (R = 98-128 and tail convex-conoid in C. rosmarini).

DISCOCRICONEMELLA DE GRISSE & LOOF, 1965

Diagnosis : Body generally curved ventrally, posterior edge of body annules smooth or finely crenate, ornamentation absent. Cephalic annule high, anteriorly directed, forming a flattened disc, often irregular and separated from body annule by neck. Submedian lobes poorly developed or absent. Stylet of variable length, rigid or flexible. Vulva closed or open. Post-vulval part rounded to elongate-conoid. Male head end conoid, lateral fields with two to four lines, bursa present or absent.

Type species : Discocriconemella limitanea De Grisse & Loof, 1965

DISCOCRICONEMELLA LIMITANEA (Luc,1959) DE GRISSE & LOOF, 1965

(Figs. 34 & 35)

Measurements

Females (n=20) : L = 180-240 (190.0±9.0) um; a = 6.2-6.7 (6.5±1.2); b = 2.5-2.7 (2.6±0.06); c = 14.2-20.6 (16.2±2.2); c' = 0.66-1.00 (0.79±0.11); V = 87.5-90.6 (88.8±1.0); stylet = 48-51 (49.5±1.4) um; conus = 40.5-43.5 (42.0±1.2) um; tail = 9.0-13.5 (12.5±1.6) um; R = 104-120; Rst = 25-27; Roes = 38-39; Rex = 34-39; Rv = 14-16; Rvan = 6-7; Ran = 7-9; VL/VB = 0.87-1.16 (1.06±0.1); St%L = 23.5-26.6 (24.7±1.0).

Description

Female : Body small, robust, arcuate to C-shaped upon fixation, narrow at head end. Body annules coarse, retrorse, 3-4 um apart at

midbody, anastomoses very frequent, sometimes forming a line on lateral field, posterior margins finely crenate. Lip region distinctly setoff , 4.5 um high, 10.5-12.0 um wide with single annule. Lip annule separated by a distinct neck from first body annule, broad, deeply indented dorsally & ventrally and smooth laterally. Amphidial apertures small, slit-like, behind oral disc. Oral disc circular with a central part surrounded by narrow collar, oral aperture located on central part of oral disc, submedian lobes absent. Cephalic framework weakly developed. First body annule about lip width wide. Stylet strongly developed, metenchium 81-85% of stylet length, telenchium 7.5-9.0 um long. Basal knobs massive, anchor-shaped, 2 um high, 6.0-7.5 um wide. Dorsal oesophageal gland opening 6 um behind spear base. Pro-metacorpus muscular, 60.0-67.5 um long with 4.5-6.0 um long valve plates. Isthmus short, stout, 3 um long. Basal bulb saccate, 9-12 um long, 4.5-6.0 um wide. Nerve ring 63-70 um from anterior end. Excretory pore 66-72 um from anterior end. Hemizonid not visible.

Reproductive system monoprodelphic. Oocytes arranged in double row at tip and single row at posterior end. Vulva a transverse slit, vagina anteriorly directed. Uterus muscular. Spermatheca spherical, 12.0-16.5 um in diameter. Post-vulval region usually showing gradual to sudden narrowing. Anus less than 0.5 vulval body widths from vulva. Tail conoid, tip bluntly rounded.

Male : Not found.

Host and locality : Soil around the roots of bamboo (Bambusa sp.) from Haldi Bari, Arunachal Pradesh.

Remarks : D. limitanea (Luc, 1959) De Grisse & Loof, 1965; D. repleta Pinochet & Raski, 1977 and D. barberi Chawla & Samathanam, 1980 *are three very closely related species*. Chawla & Samathanam (1980) synonymized D. repleta Pinochet & Raski, 1977 with D. limitanea on the similarity of morphometric values. Raski & Luc (1987) revalidated D. repleta distinguishing it from D. limitanea on the post-vulval body profile (conspicuously constricted in D. repleta against continuous in D. limitanea) and further synonymized D. barberi with D. limitanea on this character. Our specimens of D. limitanea show a continuous gradation in post-vulval body profile ranging from continuous to conspicuously constricted. This variation tends to negate the importance of the post-vulval body profile character and as such would leave no distinguishing feature between D. limitanea and D. repleta. However, SEM of the labial region clearly shows that the oral disc of D. limitanea is circular (c.f. Orton Williams, 1981; Fig. 34) while that of D. repleta is rectangular (c.f. Vovlas, 1992). On this character we consider D. repleta distinct from D. limitanea. As a consequence of the present study the synonymization of D. barberi with D. limitanea as proposed by Raski & Luc (1987) on the basis of post-vulval profile becomes doubtful. Perhaps SEM of D. barberi could provide the clue as to whether D. barberi is conspecific to D. limitanea or D. repleta.

HEMICRICONEMOIDES CHITWOOD & BIRCHFIELD, 1957

Diagnosis : Female body small to medium-sized; obese, straight or slightly ventrally curved. Body annules 51-164. Extra cuticular layer present, closely attached to inner cuticle, annules strong, round or flat; lateral fields absent. Vulva posteriorly located. Vulval lips without ornamentation; vulval flaps may be present. Tail short, conoid to rounded, tip may be annulated. Cephalic framework strongly sclerotized. Lip region without submedian lobes. Amphids with slit-like apertures. Stylet well developed; basal knobs forwardly directed, rarely rounded. Males slender, oesophagus degenerated, stylet absent. Spicules slender, slightly curved; gubernaculum short and plain. Bursa rarely present, if present weakly developed; short penial tube may be present.

Type species : Hemicriconemoides wessoni Chitwood & Birchfield, 1957

HEMICRICONEMOIDES COCOPHILUS (LOOS, 1949) CHITWOOD & BIRCHFIELD, 1957

(Figs. 36 & 37)

Measurements

Kurnool, Andhra Pradesh population

Females (n=18) : L = 330-380 (360±20) um; a = 13.0-14.5 (13.9±0.5); b = 4.0-4.5 (4.3±0.19); c = 13.0-19.4 (16.9±2.1); V = 92.0-93.9 (22.7±0.71); stylet = 45-51 (49.2±2.4) um; conus = 37.5-43.5 (41.1±2.0) um; tail = 18.0-25.5 (21.6±2.6) um; R = 122-138; Rst = 16-

18; Roes = 25-32; Rex = 25-34; Rv = 9-10; Rvan=1-2; Ran=8-9; VL/VB= 1.0-1.4 (1.2±0.14); St%L = 12.7-15.3 (13.6±0.9).

Saharanpur, Uttar Pradesh population

Females (n=20) : L = 380-470 (410±28) um; a = 14-17 (15.7±0.99); b = 4.4-5.3 (4.9±0.34); c = 15-23 (18.6±2.5); V = 89-94 (91.2±1.5); stylet = 49-63 (57.5±4.4) um; conus = 42-58 (51.5±5.4) um; tail = 20.0-27.5 (24.7±2.4) um; R = 100-120; Rst = 16-17; Roes = 22-26; Rex = 21-31; Rv = 8-10; Rvan = 1; Ran = 7-9; VL/VB = 1.3-1.7 (1.51±0.13); St%L = 13.5-16.4 (15.4±0.88).

Jalna, Maharashtra population

Females (n=15) : L = 350-420 (387±24) um; a = 15-18 (16.6±0.95); b = 4.5-5.6 (4.9±0.34); c = 14-18 (15.9±1.4); V = 92-94 (93.0±0.74); stylet = 53-58 (56.0±1.6) um; conus = 48-53 (50.3±1.78) um; tail = 22-30 (25.6±2.4) um; R = 115-128; Rst = 15-17; Roes = 23-26; Rex = 27-31; Rv = 10-11; Rvan = 1-3; Ran = 7-9; VL/VB = 1.4-1.7 (1.5±0.96); St%L = 12.0-14.5 (13.2±0.87).

Description

Female : Body ventrally arcuate upon fixation, narrowing from stylet base to head end and posterior to vulva. Outer cuticular sheath tightly enclosing body, separated on tail. Body annules coarse, flat, 4-5 um apart at midbody. Lip region slightly setoff with two annules, narrower than adjoining body, 4.5 um high. First lip annule

10.5 um wide, second 13.5 um wide. Labial region more or less round, oral disc circular, raised, with a fine rim-like collar. Oral aperture slit-like. Amphidial apertures slit-like, behind oral disc, without protruding plugs. Cephalic framework moderately sclerotized. Stylet well developed, metenchium 82-85% of stylet length, telenchium 7.5-9.0 um long. Basal knobs massive, anchor-shaped, 3 um high, 6.0-7.5 um wide. Dorsal oesophageal gland opening 3 um behind spear base. Oesophagus 78-87 um long. Pro-metacorpus muscular, 66-72 um long, 12 um wide with 7.5-9.0 um long valve plates. Isthmus 4.5 um long. Basal bulb saccate, 12-15 um long, 9 um wide. Nerve ring 67.5-75.0 um from anterior end. Excretory pore 81-90 um from anterior end. Hemizonid one annule wide, anteriorly adjacent to excretory pore.

Reproductive system monoprodelphic. Oocytes arranged in double row at tip and single row in posterior end. Vulva an open transverse slit, vulval flaps two annules long. Vagina anteriorly directed, 10.5-13.5 um long. Uterus with proximal glandular and distal muscular parts. Spermatheca oval, 15-18 um long, 12-15 um wide. Anus small, pore-like, located adjacent to vulva. Tail conoid, 1.5-2.0 anal body widths long. Tail tip finely rounded.

Male : Not found.

Host and localities : Soil around the roots of (i) sun flower (Helianthus annus) from Kurnool, Andhra Pradesh, (ii) guava (Psidium guajava) from Saharanpur, Uttar Pradesh, (iii) sweet pea (Pisum sativum) from Jalna, Maharashtra.

Remarks : This species is widely distributed in India. Loos (1949) first described this species from Sri Lanka. Later Siddiqi (1961), Edward & Misra (1963), Timm (1965), Dasgupta et al., (1969) and Decraemer & Geraert (1992) redescribed this species. The measurements of our specimens closely agree with the previous descriptions and measurements. SEM of the species clearly shows the absence of distinct lips, a feature described and illustrated by Ray et al., (1985) from specimens collected in Orissa. The SEM of lip region is almost identical to that described by Decraemer & Geraert (1992).

HEMICRICONEMOIDES GADDI (LOOS, 1949) CHITWOOD & BIRCHFIELD, 1957

(Fig. 40)

Measurements

Chikmagalur, Karnataka population

Females (n=12) : L = 410-550 (490±40) um; a = 16.5-22.7 (18.9±2.0); b = 3.6-4.5 (4.2±0.3); c = 11.4-17.3 (14.1±2.0); V = 85-90 (88.9±2.5); stylet = 82.5-87.0 (84.5±2.0) um; conus = 72-75 (73.5±1.4) um; tail = 28.5-45.0 (36.0±6.3) um; R = 159-185; Rst = 24-28; Roes = 36-44; Rex = 40-48; Rv = 13-16 ; Rvan = 4-5; Ran = 8-11; VL/VB = 2.00-3.62 (2.39±0.49); St%L = 15.6-20.4 (17.2±1.5).

Chamoli, Uttar Pradesh population

Females (n=10) : L = 390-490 (450±30) um; a = 15.2-18.1 (17.1±1.0); b = 3.8-4.6 (4.2±0.3); c = 13.0-15.5 (14.2±1.0); V = 87.9-90.2

(89.0±0.8); stylet = 69.0-82.5 (76.5±4.1) um; conus = 58.5-70.5 (65.7±3.7) um; tail = 30-36 (32.0±2.0) um; R =120-141; Rst = 17-19; Roes = 28-36; Rex = 31-38; Rv =15-17; Rvan = 5-6; Ran = 9-11; VL/VB = 2.0-2.4 (2.1±0.12); St%L = 15.6-19.2 (17.0±2.1).

Description

Female : Body ventrally arcuate upon fixation, narrowing from spear base to lip region and posterior to vulva. Outer cuticular sheath tightly enclosing body. Body annules 4.0-5.0 um apart at midbody. Lip region hemispherical, continuous, 6.0 um high with two annules. First lip annule 9.0 um wide, second 10.5-12.0 um wide. Labial region circular, oral disc slightly elevated but not protruding beyond first lip annule. Cephalic framework moderately sclerotized. Stylet well developed; metenchium slender, 82-85% of stylet length, telenchium 10.5-13.5 um long. Basal knobs massive, anchor-shaped, 3.0 um high, 6.0-7.5 um wide. Dorsal oesophageal gland opening 3.0-4.5 um from spear base. Oesophagus 105-123 um long. Pro-metacorpus muscular, 86-105 um long, 13.5-15.0 um wide with 7.5-9.0 um long valve plates. Isthmus 4.5-6.0 um long. Basal bulb saccate, 12-15 um long, 12 um wide. Nerve ring 89-108 um from anterior end. Excretory pore 120-132 um from anterior end. Hemizonid one annule wide, anteriorly adjacent to excretory pore.

Reproductive system monoprodelphic. Oocytes arranged in single row. Vulva an open transverse slit, vagina anteriorly directed, 15-18 um long; uterus muscular. Spermatheca oval, 16.5-21.0 um long, 12-15 um wide. Anus pore-like, about one vulval body width from

vulva. Tail elongate conoid, 1.7-2.3 times anal body widths or 1.2-2.0 times vulva-anus distance long, terminus finely rounded.

Male : Not found.

Host and localities : Soil around the roots of (i) coffee (Coffea arabica) from Chikmagalur, Karnataka, (ii) peach (Prunus persica) from Chamoli, Uttar Pradesh.

Remarks : The species was first reported by Loos (1949) from Sri Lanka. Siddiqi & Goodey (1963) reported this species from India. Some characters such as body length, stylet length and number of annules on body appear to be variable.

HEMICRICONEMOIDES MANGIFERAE SIDDIQI, 1961

(Figs. 38 & 39)

Measurements

Chikmagalur, Karnataka population

Females (n=15) : L = 400-470 (450±20) um; a = 16.0-18.7 (17.0±0.8); b = 4.1-5.3 (4.8±0.4); c = 18.4-22.8 (20.5±1.2); V = 91.6-92.9 (92.2±0.45); stylet = 61.5-69.0 (65.0±3.1) um; conus = 52.5-60.0 (57.0±2.8) um; tail = 19.5-24.0 (21.7±1.3) um; R = 157-166; Rst = 21-23; Roes = 28-34; Rex = 30-36; Rv = 12-13; Rvan = 4-5; Ran = 8; VL/VB = 1.3-1.6 (1.4±0.08); St%L = 13.9-15.4 (14.5±0.53).

Siddharth Nagar, Uttar Pradesh population

Females (n=15) : L = 470-610 (530±40) um; a = 17.6-21.6 (19.3±1.3); b = 4.4-5.3 (4.9±0.3); c = 15.2-24.1 (19.2±2.6); V = 91.1-93.0 (92.1±0.7); stylet = 67.5-75.0 (71.3±2.1) um; conus = 60-64 (62.7±1.7) um; tail = 24-30 (28.5±3.0) um; R = 148-165; Rst = 23-24; Roes = 31-37; Rex = 30-34; Rv = 13-16; Rvan = 3-5; Ran = 9-12; VL/VB = 1.37-1.91 (1.7±0.17); St%L = 12.1-15.1 (13.2±0.98).

Rishikesh, Uttar Pradesh population

Females (n=20) : L = 460-550 (496±28) um; a = 17.0-19.5 (18.2±0.8); b = 4.5-5.3 (4.8±0.2); c = 18.2-22.3 (19.9±1.3); V = 92-93 (92.5±0.38); stylet = 63-77 (70.5±4.0) um; conus = 56-65 (60.7±2.9) um; tail = 21.0-28.5 (24.6±2.4) um; R = 124-148; Rst = 17-20; Roes = 25-32; Rex = 31-37; Rv = 11-15; Rvan = 3-5; Ran = 7-10; VL/VB = 1.8-2.7 (2.2±0.34); St%L = 13.0-14.5 (13.6±0.5).

Description

Female : Body ventrally arcuate upon fixation, tapering from spear base to lip region and posterior to vulva. Outer cuticular sheath tightly enclosing body, sometimes separated on tail. Body annules flat, 3.0-4.5 um apart at midbody. Lip region 6 um high, slightly setoff , with two annules. First lip annule round, 8.0-10.5 um in diameter, second slightly larger in diameter than the first. Oral disc narrow, rectangular, dorso-ventrally oriented with a slit-like oral aperture. Amphidial apertures located behind oral disc and covered

by plugs. Labial plate not protruding from first lip annule. Cephalic framework moderately sclerotized. Stylet well developed; metenchium strong, 84-86% of stylet length, telenchium 9-12 um long. Basal knobs massive, anchor-shaped, 3 um high, 7.5-9.0 um wide. Dorsal oesophageal gland opening 3.0-4.5 um from spear base. Oesophagus 84-117 um long. Pro-metacorpus muscular, 72-106 um long, 13.5-16.5 um wide with 6-8 um long valve plates. Isthmus very short 4.5 um long. Basal bulb saccate, 12.0-16.5 um long, 7.5-9.0 um wide. Nerve ring 73-100 um from anterior end. Excretory pore 85-105 um from anterior end. Hemizonid inconspicuous.

Reproductive system monoprodelphic. Oocytes arranged in single row. Vulva an open transverse slit. Vagina anteriorly directed, 15-18 um long. Uterus muscular. Spermatheca spherical with sperms, 9-12 um in diameter. Anus pore-like, less than one vulval body width from vulva. Tail conoid, 1.2-1.8 anal body widths or 1.4-1.8 times vulva-anus distance long, tip smooth or annulated.

Male : Not found.

Host and localities : Soil around the roots of (i) coffee (Coffea arabica) from Chikmagalur, Karnataka, (ii) guava (Psidium guajava) from Siddharth Nagar, Uttar Pradesh, (iii) plum tree (Prunus communis) from Rishikesh, Uttar Pradesh.

Remarks : Hemicriconemoides mangiferae is the most common species of the genus in India. This species shows variation in body length,

number of body annules, length of spear and length and shape of tail tip. SEM observations on H. mangiferae show similarities in structure of tail shape and vulval shape, annules between vulva and anus as given by Vovlas et al. (1990) and Decraemer & Geraert (1992). The labial structure showing kidney-shaped fused lips and a rectangular oral disc are as described by Decraemer & Geraert (1992). From other available SEM elucidations of Hemicriconemoides species, the lip region of H. mangiferae resembles that of H. sinensis Vovlas, 1988.

HEMICRICONEMOIDES VARIABILIS n.sp.

(Figs. 41 & 42)

Measurements

Paratype females (n=8) : L = 390-450 (430±20) um; a = 16.0-17.5 (17.1±0.6); b = 3.9-4.2 (3.9±0.14); c = 9.7-12.9 (11.1±1.7); V = 86-88 (87.2±0.47); stylet = 85-95 (89.0±4.0) um; conus = 72-85 (77.5±4.7) um; tail = 33.0-46.5 (39.4±4.3) um; R = 142-154; Rst = 28-32; Roes = 34-43; Rex = 40-44; Rv = 17-21; Rvan = 5-6; Ran = 12-16; VL/VB = 2.4-2.9 (2.7±0.18); St%L = 18.9-20.8 (20.0±0.8).

Holotype female : L = 440 um; a = 17.4; b = 4.2; c = 12.9; V = 86.5; stylet = 84.0 um; conus = 72.0 um; tail = 34.5 um; R = 144; Rst = 29; Roes = 36; Rex = 42; Rv = 18; Rvan = 6; Ran = 12; VL/VB = 2.85; St%L = 18.9..

Paratype male (n = 1) : L = 370 um : a = 27.5; b = 4.7; c = 9.5; T = 52; tail = 36 um; spicules = 30 um; gubernaculum = 4.5 um; bursa = ?.

Description

Female : Body curved ventrally upon fixation, tapering towards extremities, posteriorly terminating as elongate conoid tail. Cuticular sheath closely fitting body, sometimes detached in tail region, 3-4 um apart at midbody. Lip region slightly setoff with two annules, 6 um high. First lip annule ovoid, depressed laterally, 12 um long, 9 um wide. Second annule round, 9 um in diameter. Labial region oval, oral disc dorso-ventrally elongate with slit-like oral aperture. Labial plate modified into two lateral hemispherical projections on both sides of oral disc. Amphidial apertures slit-like, behind oral disc. Cephalic framework moderately sclerotized. Stylet well developed, metenchium slender, 85-89% of stylet length long, telenchium 12 um long. Basal knobs anchor-shaped, 3 um high, 6-7 um wide. Dorsal oesophageal gland opening 3 - 4 um from spear base. Oesophagus 106 - 121 um long. Pro- metacorpus muscular, 96 - 108 um long, 15 um wide with 7.5-9.0 um long valve plates. Isthmus 3.0 - 4.5 um long. Basal bulb saccate, 10.5 - 13.5 um long. 9 um wide. Nerve ring 98-110 um from anterior end. Excretory pore 114 - 128 um from anterior end. Hemizonid one annule wide located anterior to excretory pore.

Reproductive system monoprodelphic. Oocytes arranged in double row at tip and posteriorly in single row. Vulva a

transverse slit, vagina 10.5 - 12.0 um long, anteriorly directed. Uterus with proximal glandular and distal muscular parts. Spermatheca spherical, 18.0-22.5 um in diameter, with sperms. Anus pore-like, less than one vulval body diameter from vulva. Tail elongate conoid, 2 - 3 times anal body widths or 1.7-2.8 times vulva-anus distance long, tip smoothly rounded.

Male : Vermiform, ventrally arcuate upon fixation. Lip region continuous with body, lateral fields indistinct. Spear absent, oesophagus degenerate. Hemizonid distinct, 78 um from anterior end. Excretory pore 83 um from anterior end. Spicules arcuate, 30 um long, gubernaculum trough-shaped, 4.5 um long. Bursa rudimentary. Tail elongate conoid, 3 anal body widths long with pointed tip.

Type habitat and locality: Soil around roots of peach (Prunus persica) from Haflong, Assam,

Type material :

Holotype : Female on slide Hemicriconemoides variabilis n.sp./1; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Paratypes: Females and male on slides Hemicriconemoides variabilis n.sp./2-9; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Diagnosis and relationship

Hemicriconemoides variabilis n.sp. is characterized by two lip annules, labial plates modified into semicircular sheath-

like projections, stylet 85-95 um long, vulva at 86-88% of body length, tail conical with a finely rounded terminus, bursa rudimentary, body annules 120-140, post vulval region with 18-21 annules, vulva-anus distance 5-6 annules.

Hemicriconemoides variabilis n.sp. comes close to H. chitwoodius Esser,1960; H. varionodus Choi & Geraert, 1972; H. gaddi (Loos, 1949) Chitwood & Birchfield, 1957 and H. alexis Vovlas, 1980 in having two lip annules slightly constricted from body, equal number of body annules and similar type of tail. However, it differs from all the related species in having an oval lip region with modified labial plate. It also differs from the closely related H. chitwoodius in having a shorter body, in the shape of first lip annule and stylet knobs, and larger number of post-vulval annules (L = 480-590 um; labial disc elevated and round at top, labial plate not modified, stylet knobs round, post-vulval body with 12-15 annules in H. chitwoodius). It differs from H. varionodus in having differently shaped lip region, slender metenchium, in the shape of spear knobs, position of vulva and larger number of annules in post-vulval region (lip region with round annules, labial disc slightly elevated or inconspicuous, labial plate not modified, spear knobs round with sloping anterior surfaces, V = 91-93, post-vulval annules 11-15 in H. varionodus). From H. alexis it differs in having a smaller body, longer stylet and greater number of annules in oesophageal region (L = 480-560 um, labial disc elevated, labial plate not modified, stylet 65-77 um long and Roes = 26-28 in H. alexis). H. variabilis n.sp. can be

differentiated from H. gaddi in having partially setoff lip region, nature of labial plate and a more slender tail (lip region continuous, labial region round with slightly elevated labial disc, labial plate not modified and tail conoid in H. gaddi).

Decraemer & Geraert (1992) described four types of lip regions in the genus Hemicriconemoides, the present species represents a fifth type with a narrow, dorso-ventrally located oral disc, two slit-like amphidial apertures below the oral disc and labial plate with two semicircular projections laterally.

SUBFAMILY **HEMICYCLIOPHORINAE** SKARBILOVICH,1959

Diagnosis : Moderate to large nematodes. Body cylindrical, cuticle with round, coarse, non-retrorse annules; cuticular ornamentation absent, extra-cuticular layer may present. Typical lateral fields absent but often irregularities in body annules or various longitudinal markings present. Lip region with two or three annules, weakly differentiated, rarely offset from body. Sub-median lobes absent. Stylet elongate, basal knobs rounded, posteriorly sloping. Vulval lips may be modified. Tail elongate to rounded. Male tail elongate, bursa present, spicules setaceous, long, variously shaped. Cloacal lips forming a penial tube in several species. Hypoptygma may be present. Juveniles similar to adults except for reproductive system.

Type genus : Hemicycliophora De Man,1921

Other genus : Caloosia Siddiqi & Goodey, 1964

HEMICYCLIOPHORA DE MAN, 1921

Diagnosis : Females with extra-cuticular layer, loosely attached. Lip annules two (exceptionally three) not modified, usually not separated from body annules. Vulva a transverse slit, lips rounded or modified, pointed and elongated. Vagina straight or curved. Male lip region marked by discontinuity in body annulation, usually offset, labial framework in lateral view appearing as "spectacle mark". Spicules arcuate, semicircular,

u-shaped or hook-like. Cloacal lips forming a penial tube bearing a single hypoptygma at its tip. Bursa covering less than one-third of the tail. Male tail longer than female. Fourth stage male juvenile without stylet.

Type species : Hemicycliophora typica De Man, 1921

HEMICYCLIOPHORA DHIRENDRI HUSAIN & KHAN,1967

(Figs. 49 & 50)

Measurements

Females (n = 20) : L = 600-800 (680±40) um; a = 18-26 (22.6±2.9); b = 4.6-6.3 (5.5±0.65); c = 8.5-10.4 (9.5±0.7); V = 83-85 (84.3±1.1); stylet = 55-64 (59.0±1.7)um; conus = 44-48 (46.5±1.1)um; tail = 70-82 (76.2±3.7)um; R = 170-210; Rst = 16-18; Roes = 30-36; Rex = 35-42; Rv = 25-43; Rvan = 10-15; Ran =15-28; VL/VB = 3.8-4.2 (3.9±0.13); St%L = 8.1-8.6 (8.4±0.22).

Males (n = 4): L = 520-590 (562±26)um; a = 23-26 (24.6±2.4); b = ?; c =7.0-9.2 (8.0±0.82); c'= 5.0-6.2 (5.8±0.45); excretory pore =92-105 (99.5±4.8) um; tail = 82-98 (88.5±5.0)um; spicules =36-42 (39.6±2.3)um; gubernaculum = 7.5-9.0 (8.2±0.75) um; bursa = 36-42 (39.5±2.2) um.

Description

Female : Body almost straight upon fixation, slightly narrow at head and distinctly narrow at tail end. Outer cuticle closely

fitted, attached at lip region and vulva. Body annules 3.0-4.5um apart at midbody. Lateral fields 1/5 - 1/7th body-width wide with single or double row of blocks. Lip region slightly setoff with three annules, 7.5-9.0 um high, 18.0-19.5 um wide. Labial region oblong dorso-ventrally indented. Oral disc distinctly raised, circular, differentiated into central part and broad collar. Central part of oral disc with a dorso-ventral slit-like oral aperture. Amphidial apertures wide, kidney-shaped, partially covered by "plug-like" structures, surrounded by first head annule. First lip annule depressed laterally. Cephalic framework moderately developed. Stylet well developed, metenchium slender 81-86% of stylet length, telenchium 11-12 um long. Basal knobs sloping, smoothly rounded, 3 um high, 4.5-6.0 um wide. Dorsal oesophageal gland opening 4-5 um from spear base. Oesophagus 114-140 um long, pro-metacorpus 100-122 um long with 12 um long valve plates. Isthmus 8-9 um long. Basal bulb saccate, 18-24 um long, 10-12 um wide. Nerve ring 106-126 um from anterior end. Hemizonid not visible.

Reproductive system monoprodelphic, Oocytes arranged in double row at tip and single row at posterior end. Vulva a transverse opening, vulval lips modified, about three annules long. Vagina anteriorly directed, 18-21 um long. Uterus muscular. Spermatheca oval, 18.0-22.5 um long, 15-18 um wide. Tail convex-conoid then spicate with distinct annules, terminating in a rounded tip, 3.0-4.2 times anal body widths or 2.0-2.7 times vulva-anus distance long.

Male : Body cuticle finely striated. Cuticular sheath absent. Striae 1.5-2.0 um wide. Lateral fields marked with two lines, one-fifth body width wide, areolated in oesophageal region. Spear and oesophagus degenerated. Excretory pore posterior to oesophagus. Hemizonid four to six annules anterior to excretory pore. Spicules semicircualar, gubernaculum trough-shaped. Bursa crenate. Tail conoid with rounded terminus. Penial tube distinct.

Host and locality : Soil around roots of motha grass (Cyprus rotrandus) from University Campus, Aligarh, Uttar Pradesh.

Remarks : The present specimens of H. dhirendri were collected from the type locality of the species. The measurements and descriptions conform well with the original description except in having slightly shorter spear (55-64 um against 67-70 um). When compared to other related species, H. dhirendri very closely resembles H. labiata Colbran, 1960. The structure of lip region of present specimens as seen in SEM is similar to that of H. labiata given by Van den Berg (1981) and Loof (1985). The measurements of H. dhirendri also overlap with H. labiata Colbran (1960); Loof & Heyns (1969); Van den Berg (1981 & 1990). Even the males of H. dhirendri appeared to be similar in having identical measurements and two lateral lines.

HEMICYCLIOPHORA INDICUS SIDDIQI, 1961

Mesurements

Females (n = 16) : L = 980-1140 (1030±52)um; a = 23.7-28.9 (25.3±1.4) : b = 6.4 - 7.2 (6.9±0.26); c = 6.9-8.4 (7.6±0.43); V = 80.2 - 83.1 (81.8±1.0); stylet = 72-81 (74.6±2.8) um; conus = 61.5 - 67.5 (64.8±2.2) um; tail = 120-165 (137.5±13.0)um; R = 348 - 380; Rst = 26-30; Roes = 53-61; Rex = 61-69; Rv = 79-94; Rvan = 29-36; Ran = 50-58; VL/VB = 3.4 - 4.4 (3.9±0.30); St%L = 6.7 - 7.6 (7.2±0.25).

Host and locality : Soil around roots of wild trees from Palghat, Kerala.

Remarks : H. indicus was first described by Siddiqi (1961a) from Banda, U.P. The dimensions and description of present specimens closely agree with original description. However, some variations in "C" value, R , Roes, Rex , Rv and Ran were observed and considered here as intraspecific variations.

HEMICYCLIOPHORA ATTAPADII n.sp.

(Figs. 45 & 46)

Measurements

Paratype females (n=18) : L= 1000-1200 (1100±40)um; a = 27.6-30.7 (28.8±0.96); b = 6.4-7.9 (7.2±0.38); c = 4.5-5.0 (4.7±0.18); V = 73.5-76.6 (75.5±0.98); stylet = 75-84 (80.8±2.7)um; conus = 64.5-69.0 (66.8±1.7)um; tail = 213-250 (233.0±9.8)um; R = 370-400; Rst

= 32 - 38; Roes = 62-80; Rex = 68-84; Rv = 110-150; Rvan = 30-40; Ran = 80-110; VL/VB = 6.4-8.0 (6.9±0.53); St%L = 6.8-7.7 (7.2±0.25).

Holotype female : L = 1090 um; a = 27.9, b = 7.1; c = 4.7; V = 73.5; stylet = 78 um; conus = 64.5 um; tail = 230 um; R = 390; Rst = 36; Roes = 70; Rex = 74; Rv = 122; Rvan = 32; Ran = 90; VL/VB = 8; St%L = 6.8.

Description

Female : Body ventrally curved upon fixation, strongly curved near vulva, tapering towards extremities. Outer cuticle loose, attached at lip region and vulva. Body annules 3 um apart at midbody. Lateral fields with single row of blocks occasionally with break in anastomising striae. Lip region conoid. Lip annules three, indented dorso-ventrally. Oral disc rectangular, slightly raised above the first lip annule, oral aperture slit-like. Amphidial apertures wide open, semicircular, surrounded by lip annule. First lip annule depressed laterally. Labial framework moderately sclerotized. Stylet elongate; metenchium slender, 82-86% of stylet length, telenchium 13.5-16.5 um long. Basal knobs oval, 3.0-4.5 um long. Dorsal oesophageal gland opening 4.5-6.0 um from spear base. Oesophagus 142-165 um long. Pro-metacorpus 105-130 um long, 15.0-16.5 um wide with 12.0-13.5 um long valve plates. Isthmus tubular, 12-15 um long. Basal bulb saccate,

22.5-25.5 um long, 12 um wide. Nerve ring 115-133 um from anterior end. Hemizonid indistinct. Excretory pore four to six annules posterior to basal bulb.

Reproductive system monoprodelphic. Oocytes arranged in double row at tip and single row posteriorly. Vulva a transverse opening, vulval lips modified, vulval sleeve 34.5-39.0 um long. Uterus muscular, spermatheca reduced. Tail elongate conoid, gradually tapering to finely pointed terminus, 2.5-2.7 times vulva - anus distance long.

Male : Not found.

Type habitat and lacality : Soil around roots of cashew nut (Anacardium occidentale) from Attapadi forest, Palghat, Kerala.

Type Material

Holotype : Female on slide Hemicycliophora attapadii n.sp./1; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Paratypes : Females on slides Hemicycliophora attapadii n.sp./2-9; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Diagnosis and relationship

Hemicycliophora attapadii n.sp. is characterized by a large body, conoid lip region with three annules indented dorsoventrally, rectangular oral disc, absence of longitudinal lines, modified vulval lips R > 37; Rst = 32-38, Roes = 62-80 and Rex = 68-84.

In having modified vulval lips, more than three annules long H. attapadii n.sp. comes close to H.brzeskii Barbez & Geraert, 1980; H. dahomensis Germani & Luc, 1976; H. indicus Siddiqi, 1961; H. penetrans Thorne, 1955; H. osmani Das & Shivaswamy, 1976; H. oostenbrinki Luc, 1958; H. karachiensis Maqbool et al., 1986 and H. meghalayaensis n.sp. It can however, be differentiated from all except H. dahomensis, H. osmani and H. meghalayaensis n.sp. in the absence of longitudinal striae.

It differs form H. osmani in having a smaller stylet and greater number of body annules (stylet = 130-134 um long and R = 250-266 in H. osmani). From H. dahomensis it can be differentiated by the number of lip annules, longer tail, reduced spermatheca and tail shape (lip annules two, c = 7.6-10.6, spermatheca well developed, tail not regularly tapering in H. dahomensis). It can be differentiated from H. meghalayaensis n.sp. by the structure of lip region, lip annules and oral disc; narrower body annules and greater number of annules in stylet, oesophagus and excretory pore regions (lip region low flat, only first lip annule with dorso-ventral indentation, lip annules not depressed laterally, oral disc rectangular with central and collar regions,

body annules 4 um apart at midbody, R = 295-340; Rst = 26-29; Roes = 47-50 and Rex = 51-54 in H. meghalayaensis n.sp.).

HEMICYCLIOPHORA MEGHALAYAENSIS n.sp.

(Figs. 43 & 44)

Measurements

Paratypes female (n=12) : L = 1150-1300 (1210±60) um; a = 27.2-29.8 (28.0±0.92); b = 7.2-7.7 (7.4±0.16); c = 4.0-5.0 (4.6±0.33); V = 72.5-74.4 (73.7±0.67); stylet = 84-93 (87.2±3.0) um; conus = 69-75 (72.3±2.4) um; tail = 240-285 (263.0±15.7) um; R = 295-340; Rst = 26-28; Roes = 47-50; Rex = 51-54; Rv = 86-105; Rvan = 26-30; Ran = 60-75; VL/VB = 6.5-7.3 (6.8±0.25); St%L = 6.9-7.5 (7.2±0.16).

Holotype female : L = 1220 um; a = 27.3; b=7.7; c = 4.8; V = 74.5; stylet = 88.5 um; conus = 73.5 um; tail = 252 um; R = 330; Rst = 26; Roes = 48; Rex = 53; Rv = 96; Rvan = 28; Ran = 68; VL/VB = 6.5; St%L = 7.2.

Description

Female : Body ventrally arcuate upon fixation, tapering towards extremities. Outer cuticle loose, attached at lip region and vulva. Body annules 4 um apart at midbody. Lateral field 1/5-1/7 body width wide with a row of single blocks formed by two faint lines, transverse striae meet regularly or irregularly within the blocks.

Lip region low, flat, continuous, 7.5-9.0 um high, 16.5-18.0 um wide with three annules. Labial region oblong only first lip annule slightly dorso-ventrally indented. Oral disc raised slightly above the first lip annule, narrow, rectangular in shape; differentiated into a central oral disc and narrow collar, central disc with slit-like oral aperture. Amphidial apertures wide, semicircular, partially covered by "plug-like" structures, surrounded by first lip annule. Cephalic framework moderately sclerotized. Stylet elongate; metenchium slender, 80-83% of stylet length, telenchium 15-18 um long. Basal knobs oval-shaped, 4-6 um high, 7.5 um wide with a cavity. Dorsal oesophageal gland opening 3-4 um from spear base. Oesophagus 153-175 um long. Pro-metacorpus 120-132 um long, 18 um wide with 12-15 um long valve plates. Isthmus tubular, 12 um long. Basal bulb saccate, 18-21 um long, 10.5 um wide. Nerve ring 126-147 um from anterior end. Excretory pore 166-182 um from anterior end. Hemizonid two annules wide, anteriorly adjacent to excretory pore.

Reproductive system monoprodelphic. Oocytes arranged in double row at tip and single row at posterior end. Vulva a transverse slit, vulval lips modified, vulval sleeve 33-39 um long with 13-17 annules. Vagina anteriorly directed. Uterus muscular. Spermatheca oval, 22.5-30.0 um long, 15.0-22.5 um wide. Tail elongate conoid, gradually tapering to pointed terminus, 2.2-2.8 times vulva-anus distance long.

Male : Not found.

Type habitat and locality : Soil around roots of wild grass (unidentified) from Cherapunji, Meghalaya.

Type material

Holotype : Female on slide Hemicycliophora meghalayaensis n.sp./1: deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Paratypes : Females on slides Hemicycliophora meghalayaensis n.sp./2-9; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Diagnosis and relationship :

Hemicycliophora meghalayaensis n.sp. is characterized by a large body; low, flat, continuous lip region with three lip annules; first lip annule dorso-ventrally indented, oral disc rectangular with central oval part surrounded by narrow collar; vulval lips modified, more than three annules long, R = 295-340; Rst = 26-28; Roes = 47-50; Rex = 51-54.

In having modified vulval lips more than three annules long H. meghalayaensis n.sp. comes close to H. brzeskii Barbez & Geraert, 1980; H. dahomensis Germani & Luc, 1976; H. indicus Siddiqi, 1961; H. penetrans Thorne, 1955; H. osmani Das & Shivaswamy, 1976; H. oostenbrinki Luc, 1958; H. karachiensis Maqbool et al., 1986 and H. attapadii n.sp. However, it can be

distinguished from all except H. dahomensis, H. osmani and H. attapadii n.sp. in the absence of longitudinal striae.

It differs from H. osmani in having smaller stylet and greater number of body annules (stylet = 130-134 um long and R = 250-266 in H. osmani). It can be distinguished from H. dahomensis in number of lip annules, shape of lip region, an anteriorly located vulva and tail length (lip annules two, lip region rounded, V = 76.4-80.1; c = 7.6-10.6 in H. dahomensis). It differs from H. attapadii n.sp. in having differently shaped lip region, lip annules and oral disc; wider body annules and differences in Rst, Roes and Rex (lip region conoid, all lip annules indented dorso-ventrally, oral disc rectangular without collar, body annules 3 um apart at midbody, R = 370-400; Rst = 32-38; Roes = 62-80 and Rex = 68-84 in H. attapadii n.sp.).

HEMICYCLIOPHORA POSTAMPHIDIA n.sp.

(Figs. 47 & 48)

Measurements

Paratype females (n=12) : L = 820-960 (900±50) um; a = 24.1-27.8 (25.7±1.2); b = 5.4-6.1 (5.6±0.23); c = 5.5-6.6 (6.1±0.9); V = 77-80 (79.0±1.1); stylet = 82-90 (86.2±3.0) um; conus = 70-75 (72.8±1.7) um; tail = 141-165 (153.0±7.8) um; R = 350-388; Rst = 32-35; Roes = 64-68; Rex = 63-68; Rv = 110-130; Rvan = 14-18; Ran = 96-112; VL/VB = 4.4-5.6 (5.0±0.33); St%L = 8.5-10.4 (9.5±0.71).

Holotype female : L = 940 um; a = 24.1; b = 5.6; c = 6.2; V = 79.4; stylet = 87.0 um; conus = 72.0 um; tail = 150.0 um; R = 376; Rst = 32; Roes = 65; Rex = 65; Rv = 113; Rvan = 18; Ran = 96; VL/VB = 4.8; St%L = 9.2.

Description

Female : Body ventrally curved upon fixation, tapering towards extremities. Outer cuticle loose, attached at lip region and vulva. Body annules 3-4 um apart at midbody. Lateral fields 1/5-1/7 of body width, appearing folded in the middle in the light microscope. In SEM it appears as a band of cuticular protrusion with a slight depression in the middle.

Lip region, rounded, continuous, 7.5-9.0 um high, 15.0-16.5 um wide with three annules. Labial region slightly compressed dorso-ventrally with a central oral disc and two large lateral shields. Oral disc surrounded by a distinct collar, oral aperture pore-like. Amphids distinct, amphidial apertures located just behind the oral disc, apertures partially covered by lateral shields. First lip annule incompletely surrounding labial region and divided into 4-6 unequal sectors. Cephalic framework moderately sclerotized. Stylet elongate, metenchium slender, 83-85% of stylet length, telenchium 16.5-19.5 um long. Knobs oval, 3.0-4.5 um high, 6.0-7.5 um wide with a cavity. Dorsal oesophageal gland opening 6.0-7.5 um from spear base. Oesophagus 150-168 um long. Pro-metacorpus 120-132 um long, 15.0-16.5 um wide with 12-15 um long valve plates. Isthmus tubular, 18.0-19.5

um long. Basal bulb saccate, 16.5-19.5 um long, 9.0-10.5 um wide. Nerve ring at 132-140 um from anterior end. Hemizonid two annules wide, located 2-3 annules anterior to excretory pore. Excretory pore near oesophago-intestinal junction.

Reproductive system monoprodelphic. Oocytes arranged in double row at tip and single row at posterior end. Vulva with modified lips, three body annules long, opening transverse. Vagina anteriorly directed, 18-21 um long. Uterus muscular. Spermatheca absent. Tail elongate conoid then spicate with rounded terminus, 2.5-2.8 times vulva-anus distance long.

Male : Not found.

Type habitat and locality : Soil around roots of mango (Mangifera indica) from Srinagar, Pauri Garhwal, Uttar Pradesh.

Type material

Holotype : Female on slide Hemicycliophora postamphidia n.sp./1; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Paratypes : Females on slides Hemicycliophora postamphidia n.sp./2-10; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Diagnosis and relationship

Hemicycliophora postamphidia n.sp. is characterized by a round lip region with 3 annules, amphidial apertures covered

by lateral sheilds and located away from oral disc, stylet knobs with cavity, anterior vulval lip three annules long and tail elongate conoid then spicate with finely rounded terminus.

Hemicycliophora postamphidia n.sp. comes close to H. belemnis Germani & Luc, 1973; H. euginae Khan & Basir , 1963 and H. tarjani Khan & Basir , 1963 in having identical stylet lengths, vulval lips and tail shapes. However, it differs from all three species in having three lip annules (against two), lip region with central oral disc, amphidial apertures partially closed by sheilds and located away from oral disc. It further differs from H. belemnis in having greater number of body annules, nature of lateral fields and a longer tail (R = 230-272, lateral fields with two rows of blocks, c = 6.7-10.0 in H. belemnis). From H. euginae it further differs in having a smaller body, longer oesophagus, nature of lateral fields and in the presence of a cavity in basal knobs (L = 1.0-1.6 mm; b = 6.4-8.7, knobs without cavity and lateral fields with single row of blocks in H. euginae). From H. tarjani it differs in the presence of cavity in basal knobs, different type of ornamentation on lateral fields and lesser number of annules between vulva and anus (basal knobs without cavity, lateral fields with a single line, Rvan = 28 in H. tarjani).

SUMMARY

SUMMARY

A survey of plant parasitic nematodes from different states of the Indian union viz., Andhra Pradesh, Arunachal Pradesh, Gujarat, Karnataka, Kerala, Maharashtra, Meghalaya, Uttar Pradesh and Tamil Nadu were conducted. A large number of species of plant parasitic nematodes belonging to orders Tylenchida and Dorylaimida were collected. In the present thesis the phytophagous nematodes of suborder Tylenchina have been studied. Where ever possible SEM illustrations have been provided.

In all, 55 species have been reported under two superfamilies; six families, nine subfamilies and twenty three genera. These include 17 new species. The descriptions of thirty two species have been provided,of which twenty two have been supplemented with SEM studies to understand the morphology of taxonomically important characters. The description of Brachydorus kazirangii, Trichotylenchus astriatoides and redescription of Merlinius macrodens with SEM elucidations have already been published and is appended here as appendix - I. The other papers dealing with descriptions of dorylaim species viz., Paratimminema brevibulbum, Roques indicus and Trachypleurosum indicum though not directly related with the subject have, neverthless, been appended as appendix - II.

I. The Order

Tylenchida

II. The suborder

Tylenchina

III. The super families

1. Tylenchoidea
2. Criconematoidea

IV. The families

1. Tylenchidae
2. Anguinidae
3. Belonolaimidae
4. Pratylenchidae
5. Hoplolaimidae
6. Criconematidae

V. The subfamilies

1. Tylenchinae
2. Tylodorinae
3. Atylenchinae
4. Boleodorinae
5. Telotylenchinae
6. Pratylenchinae
7. Hoplolaiminae
8. Criconematinae
9. Hemicycliophorinae

VI. The genera

1. Tylenchus
2. Filenchus
3. Malenchus
4. Cephalenchus
5. Aglenchus
6. Coslenchus
7. Psilenchus
8. Boleodorus
9. Ditylenchus
10. Tylenchorhynchus
11. Merlinius
12. Pratylenchus
13. Hirschmanniella
14. Hoplolaimus
15. Rotylenchus
16. Scutellonema
17. Helicotylenchus
18. Criconema

19. Ogma
20. Criconemella
21. Discocriconemella
22. Hemicriconemoides
23. Hemicycliophora

VII. The new species

1. Psilenchus fasciculii
2. Psilenchus kumaoensis
3. Boleodorus caricai
4. Boleodorus constrictus
5. Ditylenchus domesticus
6. Tylenchorhynchus rosensis
7. Tylenchorhynchus cherapunjii
8. Merlinius orientalis
9. Scutellonema bambusai
10. Scutellonema cephalodiscus
11. Scutellonema shamimi
12. Criconema retrolabiata
13. Criconemella chamolii
14. Hemicriconemoides variabilis
15. Hemicycliophora attapadii
16. Hemicycliophora meghalayensis
17. Hemicycliophora postamphidia

VIII. The known species described

1. Filenchus sandneri
2. Malenchus undulatus

3. Hirschmanniella oryzae
4. Hoplolaimus indicus
5. Hoplolaimus chambus
6. Scutellonema brevistylatum
7. Scutellonema grande
8. Helicotylenchus incisus
9. Criconema aberrans
10. Ogma civellae
11. Discocriconemella limitanea
12. Hemicriconemoides cocophilus
13. Hemicriconemoides gaddi
14. Hemicriconemoides mangiferae
15. Hemicycliophora dhirendri

IX. The known species (only dimensions & remarks given)

1. Tylenchus ritae
2. Malenchus acarayensis
3. Cephalenchus cephalodiscus
4. Cephalenchus leptus
5. Aglenchus muktii
6. Coslenchus areolatus
7. Coslenchus cocophilus
8. Tylenchorhynchus coffeae
9. Tylenchorhynchus goffarti
10. Tylenchorhynchus leviterminalis
11. Tylenchorhynchus mashhoodi
12. Tylenchorhynchus mangiferae

13. Tylenchorhynchus phaseoli
14. Tylenchorhynchus capitatus
15. Merlinius brevidens
16. Pratylenchus flakkensis
17. Pratylenchus zeae
18. Hirschmanniella gracilis
19. Rotylenchus indorobustus
20. Helicotylenchus paracanalis
21. Helicotylenchus retusus
22. Criconema medani
23. Hemicycliophora indicus

X. The new records of known species from India

1. Filenchus sandneri
2. Malenchus undulatus

REFERENCES

AHMAD, W. & AHMAD, I. (1992). Makatinus heynsi n.sp. (Dorylaimida : Aporcelaimidae) from Goa, India. Fundam. Appl. Nematol. **15**: 149-152.

ALLEN, M.W. (1955). A review of the nematode genus Tylenchorhynchus. Univ. Calif. Publ. Zool. **61**: 129-166.

ALLEN, M.W. & SHER, S.A. (1967). Taxonomic problems concerning the phytoparasitic nematodes. Ann. Rev. Phytopath. **5**: 247-264.

ANDRASSY, I. (1958). Hoplolaimus tylenchiformis Daday, 1905 (syn. H. coronatus Cobb, 1923) und die Gattungen der Unterfamilie Hoplolaiminae Filipjev, 1936. Nematologica 3: 44-56.

ANDRASSY, I. (1962). Zwei neue Nematoden - Arten aus dem Uebersch-wemmungsebiet der Dounau (Danubialia Hungarica, XIII). Opusc. Zool. Bpest. **4**: 3-8.

ANDRASSY, I. (1968). Fauna Paraguayensis. 2. Nematoden aus den Ga leriewaldern des Acaray-Flusses. Opusc. Zool. Bpest. 8: 167-315.

ANDRASSY, I. (1976). Evolution as a basis for the systematization of nematodes. Pitman Publishing, London. 288 pp.

ANDRASSY, I. (1981). The genera and species of the family Tylenchidae Orley, 1880 (Nematoda). The genus Malenchus Andrassy, 1968. Acta. Zool. Hung. **27**: 1-47.

ANDRASSY, I. (1984). The genera and species of the family Tylenchidae Orley, 1880 (Nematoda). The genera Cephalenchus (Goodey, 1962) Golden, 1971 and Allotylenchus gen.n. Acta. Zool. Hung. **30**: 1-28.

ANDERSON, R.V. (1983). Morphological characteristics of Hoplolaimus indicus Sher, 1963 in Canada, a parasite of wild rice. J. Nematol. **15**: 366-369.

BAQRI, Q.H. & JAIRAJPURI, M.S. (1970). On the intra-specific variations of Tylenchorhynchus mashhoodi Siddiqi & Basir 1959 and an emended key to species of Tylenchorhynchus Cobb, 1913 (Nematoda). Rev. Brasil. Biol. **30**: 61-68.

BARBER, C.A. (1901). A tea eelworm disease in South India . Department of Land Records and Agriculture, Madras Agricultural Branch 2. Bull. No., 45.

BARBEZ, D. & GERAERT, E. (1980). Two new species of the genus Hemicycliophora (Nematoda : Tylenchida) from Mount Kenya. Nematologica **26**: 108-116.

BASTIAN, H.C. (1865). Monograph on the Anguillulidae, or free nematoids, marine, land and freshwater, with descriptions of 100 new species. Trans. Linn. Soc. London **25**: 73-184.

BAUJARD, P. & LUC, M. (1985). Some SEM data on Neocrossonema aquitanense (Fies, 1968) Ebsary, 1981 (Nematoda : Criconematidae). Revue Nematol. **8**: 86-87.

BERKELEY, M.J. (1855). [Vibrios forming cysts on the roots of cucumbers]. (Editorial) Gdnr's Chron. No. **14**: 220 pp.

BRZESKI, M.W. & SAUER, M.R. (1982). Scanning electron micrography of some Tylenchidae and Boleodoridae and reappraisal of the Boleodoridae. Nematologica **28**: 437-446.

BUTLER, E.J. (1913). An eelworm disease of rice. Agr. Res. Inst. Pusa, India. Bull. **34**.

BUTLER, E.J. (1919). The rice worm (Tylenchus angustus) and its control. Botanical series **X**: 1-37.

BUTSCHLI, O. (1873). Beitrage zur kenntnis der freilebenden Nematoden. Nova. Acta. Acad. Nat. Curios. **36**: 1-124.

CASTILLO, P., SIDDIQI, M.R. & BARCINA, A.G. (1988). Criconemella rosmarini sp.n. (Criconematidae : Tylenchida) from Spain. Nematol. medit. **16**: 19-23.

CHATURVEDI, Y. & KHERA, S. (1979). Studies on Taxonomy, Biology and Ecology of nematodes associated with Jute crop. Tech Monograph, Zoological Survey of India. Vol. No. **2**: 105 pp.

CHAWLA, M.L. & SAMATHANAM, G.J. (1980). Three new species of the superfamily Criconematoidea (Tylenchida : Nematoda) from Tamil Nadu (India). Indian J. Nematol. **10**: 59-68.

CHAWLA, M.L. & YADAV, S.M. (1980). Effect of pot culturing on morphometric characters of Hoplolaimus indicus. Indian J. Nematol. **10**: 246-247.

CHITWOOD, B.G. & BIRCHFIELD, W. (1957). A new genus Hemicriconemoides (Criconematidae : Tylenchida). Proc. Helm. Soc. Washington **24**: 80-86.

CHITWOOD, B.G. & CHITWOOD,M.B. (1937). An introduction to nematology. Monumental Printing Co., Baltimore. 53 pp.

CHOI, Y.E. & GERAERT, E. (1972). Some remarkable Tylenchida from Korea. Nematologica **12**: 66-73.

COBB, N.A. (1893). Nematodes, mostly Australian and Fijian. Macleay Mem. Vol. Linn. Soc. N.S.W., 252-308.

COBB, N.A. (1920). One hundred new nemas (Type species of 100 new genera). Contrib. Sci. Nematol. **IX**: 217-343.

COBB, N.A. (1932). The English word "nema". J. Amer. Med. Assoc. **98**: 75 p.

COLBRAN, R.C. (1960). Studies of plant and soil nematodes. 3. Belonolaimus hastulatus, Psilenchus tumidus and Hemicycliophora labiata three new species from Queensland. Queensland J. Agric. Sci. **17**: 175-181.

CORBETT, D.C.M. & CLARK, S.A. (1983). Surface features in the taxonomy of Pratylenchus species. Revue Nematol. **6**: 85-98.

COURTNEY, W.D., POLLEY, D. & MILLER, V.L. (1955). TAF, an improved fixative in nematode technique. Pl. Dis. Reptr. 39: 570-571.

DAREKAR, K.S. & KHAN, E. (1977). Soil and plant parasitic nematodes from Maharashtra, India. VI. Three new species of Helicotylenchus Steiner, 1945 (Tylenchida : Nematoda). Indian J. Nematol. **8**: 132-139.

DASGUPTA, D.R., RASKI, D.J. & VANGUNDY, S.D. (1969). Revision of the genus Hemicriconemoides Chitwood & Birchfield, 1957 (Nematoda : Criconematidae). J. Nematol. **1**: 126-145.

DAS, V.M. (1960). Studies on the nematode parasites of plants in Hyderabad. Z. Parasitkde. **19**: 553-605.

DAS, V.M. & SHIVASWAMY, V. (1977). Hoplolaimus singhi n.sp. and Hemicycliophora osmani n.sp. from Andhra Pradesh, India. Riv. Parasitol. **37**: 259-264..

DASTUR, J.F. (1936). A nematode disease of rice in the central provinces. Proc. Indian Acad. Sci. **4**: 108-122.

DECKER, H. (1969). Phytonematologie. Biologie und Bekampfung Pflzen-parasitarer Nematoden. VEB Deutsch. Landwirt, Berlin. 526 pp.

DECRAEMER, W. & GERAERT, E. (1992). Description of Hemicriconemoides parataiwanensis sp.n. (Criconematidae) and four other Hemicriconemoides species from Papua New Guinea with a consideration of variability in the genus. Nematologica **38**: 267-295.

DE GRISSE, A. (1979). SEM observations on the sensory organs in the head region of tylenchid nematodes. In Scanning electron microscopy. III: 489-495.

DE GRISSE, A. & LOOF, P.A.A. (1965). Revision of the genus Criconemoides (Nematoda). Meded. Landb. Hogesch. Gent. 30: 577-603.

DE GRISSE, A. & LOOF, P.A.A. (1967). Macroposthonia annulatiformis n.sp. (Criconematidae). Nematologica 13: 459-465.

DE GUIRAN, G. (1963). Quatre especes nouvelles du genre Criconemoides (Taylor) (Nematoda : Criconematidae). Rev. Path. Veg. Ent. Agric. France 42: 1-11.

DEY, S. & BAQRI, Q.H. (1985). Nematodes from West Bengal (India) XX. Morphometric and allometric variations in Hirschmanniella gracilis (De Man, 1880) Luc & Goodey, 1963 (Radopholidae : Tylenchida). Indian J. Helminth. 2: 71-80.

DIAB, K.A. & JENKINS, W.R. (1966). Three new species of Criconemoides (Nematoda : Criconematidae). Proc. Helm. Soc. Washington 33: 5-7.

DROPKIN, V.H. (1980). Introduction to Plant Nematology. John Wiley & Sons, Inc., New York. 293 pp.

DUJARDIN, F. (1845). Histoire naturelle des helminths. Paris. 645 pp.

EDWARD, J.C. & MISRA, S.L. (1963). Hemicriconemoides communis n.sp. and H. litchi n.sp. (Nematoda : Criconematidae) from Uttar Pradesh, India. Nematologica 9: 405-411.

EDWARD, J.C. & MISRA, S.L. (1968). Heterodera vigni n.sp. and second stage larvae of Heterodera sp. in Uttar Pradesh, India. The Allahabad Farmer 42: 155-159.

EDWARD, J.C., MISRA, S.L. & SINGH, G.R. (1965). Hemicriconemoides birchfieldi n.sp. (Nematoda : Criconematidae) from Allahabad, Uttar Pradesh, India, with a revision of the key to species of Hemicriconemoides. Nematologica 11: 157-161.

EDWARD, J.C., MISRA, S.L., PETER, E. & RAI, B.B. (1971). A new species of Criconema associated with pomegranate (Punica granatum). Indian J. Nematol. 1: 59-62.

EGUNJOBI, O.A. (1967). Four new species of the genus Tylenchus Bastian, 1865 (Nematoda : Tylenchida). Nematologica 13: 417-424.

ESSER, R.P. (1960). Three additional species in the genus Hemicriconemoides Chitwood and Birchfield, 1957 (Nemata : Tylenchida). Nematologica **5**: 64-71.

FILIPJEV, I.N. (1934). The classification of the free-living nematodes and their relation to the parasitic nematodes. Smithson misc. Collect. **89**: 1-63.

FORTUNER, R. (1976). Pratylenchus zeae. C.I.H. Descriptions of plant parasitic nematodes. Set 6. No. 77. Farnham Royal UK: Commonwealth Agricultural Bureaux.

FORTUNER, R. & LUC, M. (1987). A reappraisal of Tylenchina (Nemata). 6. The family Belonolaimidae Whitehead, 1960. Revue Nematol. **10**: 183-202.

FORTUNER, R. & MAGGENTI, A.R. (1987). A reappraisal of Tylenchina (Nemata) 4. The family Anguinidae Nicoll, 1935 (1926). Revue Nematol. **10**: 163-176.

FUCHS, G. (1914). Uber Parasiten und andere biologisch an die Borkenkafer gebundene Nematoden. Vershandl Gasellsch. Deutsch. Naturf. u. Arzte (85 Vers., Wien), Teil. 2: 689-692.

FUCHS, G. (1915). Die Naturgeschichte der Nematoden und einiger anderer Parasiten von Ips typographus L. und Hylobius abietis L. Zool. Jb. 38: 109-222.

GANGULY, S. & KHAN, E. (1983). Trophurus impar sp.n. and Scutellonema eclipsi sp.n. (Nematoda : Tylenchida). Indian J. Nematol. **13**: 230-236.

GERAERT, E. (1966). The systematic position of the families Tylenchulidae and Criconematidae. Nematologica **12**: 362-368.

GERAERT, E. & RASKI, D.J. (1987). A reappraisal of Tylenchina (Nemata). 3. The family Tylenchidae Orley, 1880. Revue Nematol. **10**: 143-161.

GERAERT, E. & RASKI, D.J. (1988). Study of some Aglenchus and Coslenchus species (Nemata : Tylenchida). Nematologica **34**: 6-46.

GERMANI, G. & LUC, M. (1973). Contribution a letude du genre Hemicycliophora De Man, 1921 (Nematoda : Tylenchida) comportant la description de cinq nouvelles especes. Cah. O.R.S.T.O.M. Ser. Biol. **21**: 67-84.

GERMANI, G. & LUC, M. (1976). Two new species of Criconematidae: Hemicycliophora dahomensis n.sp. and Criconemoides parakouensis n.sp. (Nematoda : Tylenchida). Cah. O.R.S.T.O.M. Ser. Biol. **11**: 203-208.

GERMANI, G., BALDWIN, J.G., BELL, A.H. & WU, X.Y. (1985). Revision of the genus Scutellonema Andrassy, 1958 (Nematoda : Tylenchida). Revue Nematol. **8**: 289-320.

GOLDEN, A.M. (1971). Classification of the genera and higher categories of the order Tylenchida (Nematoda). In: Plant parasitic nematodes (Eds. Zuckerman, B.M., Mai W.F. & Rohde, R.A.). Academic Press, London & New York. 191-232.

GOLDEN, A.M. (1986). Morphology and Identification of Cyst nematodes. In: Cyst nematodes. (Eds. Lamberti, F., Taylor, C.E.). Plenum Press, New York. 23-45.

GOODEY, J.B. (1963). Soil and Freshwater Nematodes, by T. Goodey, rewritten. Methuen & Co. Ltd., London. 544 pp.

GOODEY, T. (1933). Plant Parasitic Nematodes and the Diseases they Cause. E.P. Dutton & Co. Inc., London. 306 pp.

GOODEY, T. (1951). Soil and Freshwater Nematodes. Methuen & Co. Inc., London. 390 pp.

GUPTA, N.K. & UMA (1980). Description of two new species of the genus Tylenchorhynchus Cobb, 1913 - family Tylenchorhynchidae (Eliava, 1964) Golden, 1971 from India. Rev. Iber. Parasitol. **40**: 423-427.

HEYNS, J. (1971). A guide to the plant and soil Nematodes of South Africa. A.A. Balkema, Cape Town. 233 pp.

HIRSCHMANN, H. (1981). Scanning electron microscopy as a tool in nematode taxonomy. In: Concepts in nematode systematics. (Eds. Stone, A.R., Platt, H.M. & Khalil, L.F.). Academic Press, London & New York. 95-111.

HIRSCHMANN, H. (1985). The genus Meloidogyne and morphological characters differentiating its species. In: An advanced treatise on Meloidogyne. Vol. I: Biology and Control. (Eds. Sasser, J.N., Carter, C.C.). North Carolina State University Graphics, Raleigh. 79-93.

HOPPER, B.E. (1959). Three new species of the genus Tylenchorhynchus (Nematoda : Tylenchida). Nematologica **4**: 23-30.

HUANG, G.S. & RASKI, D.J. (1986). Four new species of Gracilacus Raski, 1962 (Criconematoidea : Nemata). Revue Nematol. 9: 347-356.

HUSAIN, S.I. & KHAN, A.M. (1965). Two new species of Boleodorus Thorne, 1941 (Nematoda : Neotylenchidae) from India. Proc. Helm. Soc. Washington **32**: 176-179.

HUSAIN, S.I. & KHAN, A.M. (1967). A new subfamily, a new subgenus and eight new species of nematodes from India belonging to superfamily Tylenchoidea. Proc. Helm. Soc. Washington **34**: 175-186.

HUSAIN, S.I. & KHAN, A.M. (1974). Three new species of neotylenchid nematodes from North India. Indian J. Nematol. **4**: 81-87.

HUSAIN, Z. & RASHID, A. (1969). Studies on morphological variations in Hoplolaimus indicus Sher, 1963. All India Nematol. Symp., New Delhi, 27 p.

JAIRAJPURI, M.S. (1962). On a new nematode Boleodorus indicus n.sp. from soil around the roots of Onions, Allium cepa. Z. Parasitkde. **22**: 214-216.

JAIRAJPURI, M.S. (1985). Quinisulcius capitatus. C.I.H. Description of plant parasitic nematodes. Set 8. No. 111. Farnham Royal UK : Commonwealth Agricultural Bureaux.

JAIRAJPURI, M.S. (1990). Revision of Tylenchorhynchinae (Nematoda : Tylenchida). In: Progress in Plant Nematology (Eds. Saxena, S.K., Khan, M.W., Rashid, A. & Khan, R.M.). CBS Publishers & Distributors Pvt. Ltd., New Delhi. 37-58.

JAIRAJPURI, M.S. & BAQRI, Q.H. (1973). Nematodes of High Altitudes in India. I. Four new species of Tylenchida. Nematologica **19**: 19-30.

JAIRAJPURI, M.S. & RAHMANI, S.A. (1979). An ideal sealing medium for nematode mounts. Indian J. Nematol. **8**: 177.

JAIRAJPURI, M.S. & SIDDIQI, A.H. (1963). On Psilenchus neoformis n.sp. (Nematoda : Tylenchida) from Solon (H.P.), North India. Curr. Sci. **32**: 318-319.

JAIRAJPURI, M.S. & SIDDIQI, A.H. (1963a). On three new species of the genus Criconemoides Taylor, 1936 (Nematoda : Criconematidae) from North India . Z. Parasitkde. 23: 340-347.

JAIRAJPURI, M.S. & SIDDIQI, M.R. (1969). Paurodontoides n.gen. (Paurodontidae) with an outline classification of Neotylenchoidea n.rank. Nematologica **15**: 287-288.

KAUSHAL, K.K. & SWARUP, G. (1988). Two new cyst nematode species from India. Indian J. Nematol. **18**: 299-306.

KHAN, A.M. & SIDDIQI, M.R. (1968). Three new species of Nothotylenchus (Nematoda : Neotylenchidae) from North India. Nematologica **14**: 369-376.

KHAN, E. (1969). On the classification of Tylenchoidea (abstract). All India Nematol. Symp., August 21-22, 1969, New Delhi. 26 p.

KHAN, E. & BASIR, M.A. (1963). Two new species of the genus Hemicycliophora De Man, 1921 (Nematoda : Criconematidae) from North India. Nematologica **9**: 101-105.

KHAN, E. & BASIR, M.A. (1964). Boleodorus similis n.sp. (Nematoda : Neotylenchinae) from India. Z. Parasitkde. **23**: 121-123.

KHAN, E. & CHAWLA, M.L. (1975). Hoplolaimus indicus. C.I.H. Descriptions of plant parasitic nematodes. Set 5. No. 66. Farnham Royal UK : Commonwealth Agricultural Bureaux.

KHAN, E., CHAWLA, M.L. & SAHA, M. (1975). Criconematoidea (Nematoda : Tylenchida) from India, with descriptions of nine new species, two new genera and a family. Indian J. Nematol. **5**: 70-100.

KHAN, S.H. & BASIR, M.A. (1965). Scutellonema mangiferae n.sp. (Nematoda : Hoplolaimidae) from India. Proc. Helm. Soc. Washington **32**: 136-138.

KHEIRI, A. (1971). Two new species of Nothotylenchus Thorne, 1941 from Iran and a redescription of N. affinis Thorne, 1941 (Nematoda : Neotylenchidae) with a key to the species of the genus. Nematologica **16**: 591-600.

KHERA, S. (1970). Nematodes from the banks of still and running waters. 8. Order Tylenchida. Proc. Zool. Soc. Calcutta **23**: 53-65.

KIRJANOVA, E.S. & KRALL, E.L. (1969 & 71). Parasitic nematodes of plants and their control. Izdatelstvo Nauka, Vol. I & II. Leningrad, USSR. 447 pp. & 522 pp.

KUHN, J. (1857). Ueber das Vorkommen von Anguillulen in erkrankten Bluhtenkopfen von Dipsacus fullonum L. Z. Wiss. Zool. 9: 129-137.

LAMBERTI, F. & TAYLOR, C.E. (1985). Cyst Nematodes. NATO ASI series, Plenum Press, London & New York. 467 pp.

LOOF, P.A.A. (1985). Scanning electron microscope studies on the genus Hemicyliophora de Man, 1921 sensulato (Nematoda : Criconematoidea). Revue Nematol. 8: 113-123.

LOOF, P.A.A. & HEYNS, J. (1969). Taxonomy of Hemicyliophora species from South Africa (Nematoda : Criconematoidea). Nematologica 15: 464-472.

LOOS, C.A. (1949). Notes on free living and plant parasitic nematodes of Ceylon. 4. J. Zool. Soc. India 1: 17-22.

LUC, M. (1958). Trois nouvelles especes africaines du genre Hemicycliophora De Man, 1921 (Nematoda : Criconematidae). Nematologica 3: 15-25.

LUC, M. (1959). Nouveaux Criconematidae de la zone intertropicale (Nematoda : Tylenchida). Nematologica 4: 16-22.

LUC, M. (1970). Contribution a letude du genre Criconemoides Taylor, 1936 (Nematoda : Criconematidae). Cah. O.R.S.T.O.M. Ser. Biol. 11: 69-131.

LUC, M. (1987). A reappraisal of Tylenchina (Nemata). 7. The family Pratylenchidae Thorne, 1949. Revue Nematol. 10: 203-218.

LUC, M., MAGGENTI, A.R., FORTUNER, R., RASKI, D.J. & GERAERT, E. (1987). A reappraisal of Tylenchina (Nemata). 1. For a new approach to the taxonomy of Tylenchina. Revue Nematol. 10: 127-134.

LUC, M. & RASKI, D.J. (1981). Status of the genera Macroposthonia, Criconemoides, Criconemella and Xenocriconemella (Criconematidae : Nematoda). Revue Nematol. 4: 3-21.

LUQMAN, M. & KHAN, S.H. (1986). Three new nematode species attacking fruit trees in India. Indian J. Nematol. 15: 202-208.

MAGGENTI, A.R. (1981). General Nematology. Springer-verlag, New York, Heidelberg, Berlin. 372 pp.

MAGGENTI, A.R., LUC, M., RASKI, D.J., FORTUNER, R. & GERAERT, E. (1987). A reappraisal of Tylenchina (Nemata). 2. The suborder Tylenchina. Revue Nematol. 10: 135-142.

MAN, J.G. DE (1876). Onderzoekingen over vrij in de aarde levende Nematoden. Tijdschr. Nederl. Dierk. Ver. 2: 78-196.

MAN, J.G. DE (1880). Die einheimischen, frei in der reinen Erde und im sussen Wasser lebenden Nematoden, Vorlaufiger Bericht and descriptiv-systematischer Theil. Tijdschr. Nederl. Dierk. Ver. 5: 1-104.

MAN, J.G. DE (1884). Die frei in der reinen Erde und im sussen Wasser lebenden Nematoden der neiderlandischen Fauna. Leiden. 1-206.

MAN, J.G. DE (1921). Nouvelles recherches sur les nematodes libres terricoles de la Hollande. Capita Zool. 1: 3-62.

MAQBOOL, M.A., SHAHINA, F. & ZARINA, B. (1986). Two new species of Hemicycliophorinae Skarbilovich, 1959 (Nematoda : Criconematidae) from Pakistan. Pakistan J. Nematol. 4: 43-49.

MEHTA, U.K. & RASKI, D.J. (1971). Revision of the genus Criconema Hofmanner and Menzel, 1914 and other related genera (Criconematidae : Nematoda). Indian J. Nematol. 1: 145-198.

MEYL, A.H. (1961). Die freilebenden Erd-und Susswasser nematoden (Fadenwurmer). In: Die Tierwelt Mitteleuropas. Verlag Quelle & Meyer, Leipez, GDR. 164 pp.

MULK, M.M. & JAIRAJPURI, M.S. (1972). A redescription of Tylenchorhynchus phaseoli Sethi and Swarup, 1968. Indian J. Nematol. 2: 11-20.

MULVEY, R.H. (1974). Cone-top morphology of the white females and cysts of the genus Heterodera (Subgenus Heterodera), a cyst forming nematode. Can. J. Zool. 52: 77-81

NEEDHAM, T. (1744). A letter concerning certain chalky tubulous concretions, called malm; with some microscopical observations on the farina of the red lily, and of worms discovered in smutty corn. Philos. Trans. roy. Soc. London 42: 634-641.

NICKLE, W.R. (1984). Plant and Insect Nematodes. Marcel Dekker, Inc., New York & Basil. 925 pp.

ORLEY, L. (1880). [Monograph of the Anguillulids]. Termeszet. Fuzetek 4: 16-150 (in Magyar and German).

ORTON WILLIAMS, K.J. (1981). Revision of the genus Discocriconemella De Grisse & Loof, 1965 and the erection of the new genus Acrozostron (Nematoda : Criconematoidea). Syst. Parasitol. 2: 133-138.

OTHMAN, A.A., BALDWIN. J.G., MUNDO-OCAMPO, M. (1988). Comparative morphology of Globodera, Cactodera and Punctodera spp; (Heteroderidae) with scanning electron microscopy. Revue Nematol. 11: 53-63.

PAETZOLD, D. (1958). Beitrage zur Nematoden fauna mitteldeutsher Salz stellen in Raum von Halle. Wissenschatlichen Zeitschrift der Martin Luther-Universtat Halle - Wittenberg 8: 17-48.

PARAMONOV, A.A. (1962). Principles of phytonematology Vol. I. Izdatelstvo "Nauka". Mascow, USSR. 480 pp.

PARAMONOV, A.A. (1967). (A critical review of the suborder Tylenchina (Filipjev, 1934) (Nematoda : Secernentea)). Akad. Nauka.SSR. Trudy gelmint. Lab. 18: 78-101.

PARAMONOV, A.A. (1968). (Principles of ecological and morphological analysis of the classification of Tylenchida). Izdatelstvo. Acad. Nauk SSR. Ser. Biol. 6: 793-801.

PARAMONOV, A.A. (1970). (Principles of phytonematology. Vol. III). Taxonomy of nematodes of the superfamily Tylenchoidea). Izdatelstvo "Nauka". Mascow, USSR. 253 pp.

PHUKAN, P.N. & SANWAL, K.C. (1980a). Two new species of Aglenchus and record of Cephalenchus leptus (Tylenchidae: Nematoda) from Assam. Indian J. Nematol. 10: 28-34.

PHUKAN, P.N. & SANWAL, K.C. (1980b). Two new species of Macroposthonia De Man, 1880 (Criconematidae : Nematoda) from Assam. Indian J. Nematol. 10: 135-140.

PHUKAN, P.N. & SANWAL, K.C. (1982). Tylenchorhynchus paranudus sp.n. and T. annulatus (Cassidy, 1930) Golden, 1971 from Assam. Indian J. Nematol. 12: 383-385.

PINOCHET, J. & RASKI, D.J. (1977). Discocriconemella repleta n.sp. and the male of Criconemoides incistatus Hoffmann, 1974 (Criconematidae : Nematoda). J. Nematol. 8: 321-330.

POWERS, T.O., BALDWIN, J.G. & BELL, A.H. (1983). Taxonomic limits of the genus Nagelus (Thorne and Malek, 1968) Siddiqi, 1979 with a description of Nagelus borealis n.sp. from Alaska. J. Nematol. **15**: 582-593.

RAHAMAN, P.F., AHMAD, W., KHAN, Z. & AHMAD, I. (1992). Two new species of Tylenchoidea with observations on Merlinius macrodens (Allen, 1955) Siddiqi, 1970. Fundam. Appl. Nematol. **15**: 309-317.

RASHID, A. & SINGH, K. (1982). Tylenchorhynchus goldeni sp.n. (Nematoda : Tylenchida) from sugarcane soil in India. Indian J. Nematol. **12**: 193-194.

RASKI, D.J., GERAERT, E. (1985). New species of Lelenchus Andrassy, 1954 and Ecphyadophora De Man, 1921 (Nemata: Tylenchidae) from Southern Chile. Nematologica **31**: 244-265.

RASKI, D.J. & GERAERT, E. (1986). Descriptions of two new species and other observations on the genus Cephalenchus Goodey, 1962 (Nemata : Tylenchidae). Nematologica **32**: 56-78.

RASKI, D.J. & GERAERT, E. (1986a). Review of the genus Filenchus Andrassy, 1954 and description of six new species (Tylenchidae : Nemata). Nematologica **32**: 265-311.

RASKI, D.J. & LUC, M. (1987). A reappraisal of Tylenchina (Nemata) 10. The super family Criconematoidea Taylor, 1936. Revue. Nematol. **10**: 409-444.

RASKI, D.J. & LUC, M. (1988). SEM data on Brachydorus swarupi Koshy, Raski & Sosamma, 1981, and considerations on the taxonomic position of the genus Brachydorus De Guiran & Germani, 1968 (Nemata : Dolichodoridae). Revue. Nematol. **11**: 365-368.

RAY, S. & DAS, S.N. (1978). Hemicaloosia americana n.gen., n.sp. (Nematoda : Hemicycliophoridae) from Orissa, India. J. Res. OUAT, Bhubaneshwar **8**: 131-138.

RAY, S. & DAS, S.N. (1980). Nematodes of saline soils in Orissa, India. Indian J. Nematol. **10**: 231-235.

RAY, S., DAS, S.N. & MOHAPATRA, U.K. (1986). Morphological, morphometric and allometric variation in Hemicriconemoides cocophilus from Orissa, India. Indian J. Nematol. **15**: 180-185.

RUHM, W. (1956). Die Nematoden der Ipiden. Parasit. SchrReihe **6**: 437 pp.

SABOVA, N. (1967). Two new soil inhabiting nematode species (Tylenchorhynchus tatrensis and Alaimus andrassyi n.sp .) from Czechoslovakia. Opusc. Zool. Bpest. **7**: 237-240.

SAUER, M.R. & WINOTO, R. (1975). The genus Helicotylenchus Steiner, 1945 in West Malaysia. Nematologica **21**: 341-350.

SCHACHT, H. (1859). Ueber einige Feinde und Krankheiten der Zuckerrbe. Ver. Rubenzuckers - Ind. Zollver. **9**: 239-350.

SEINHORST, J.W. (1968). Three new Pratylenchus species with a discussion of the cephalic framework and of the spermatheca in this genus. Nematologica **14**: 497-510.

SETHI, C.L. & SWARUP, G. (1968). Plant parasitic nematodes of North Western India I. The genus Tylenchorhynchus. Nematologica **14**: 77-88.

SHAFQAT, S., AHMAD, I., AHMAD, W. & BILGRAMI, A.L. (1991). Scanning electron microscopic study on Dorylaimus stagnalis Dujardin, 1845. Revue Nematol. **14**: 511-515.

SHER, S.A. (1963). Revision of the Hoplolaiminae (Nematoda) II. Hoplolaimus Daday, 1905 and Aorolaimus n.gen. Nematologica **9**: 267-295.

SHER, S.A. (1964). Revision of the Hoplolaiminae (Nematoda) III. Scutellonema Andrassy, 1958. Nematologica **9**: 421-443.

SHER, S.A. (1966). Revision of the Hoplolaiminae (Nematoda) VI. Helicotylenchus Steiner, 1945. Nematologica **12**: 1-56.

SHER, S.A. (1968). Revision of the genus Hirschmanniella Luc & Goodey, 1963 (Nematoda : Tylenchoidea). Nematologica **14**: 243-275.

SHER, S.A. (1973). The classification of Telotylenchus Filipjev, 1936 Leiptotylenchus n.gen. (Leiptotylenchinae n.subf.) and Triversus n.gen. (Nematoda : Tylenchoidea). Nematologica **19**: 318-325.

SHER, S.A. (1974). Sauertylenchus labiodiscus n.gen., n.sp. from Australia (Nematoda : Tylenchorhynchinae). J. Nematol. **6**: 37-40.

SHER, S.A. & BELL, A.H. (1975). Scanning electron micrographs of the anterior region of some species of Tylenchoidea (Tylenchida : Nematoda). J. Nematol. **7**: 70-83.

SIDDIQI, M.R. (1959). Basiria graminophila n.g., n.sp. (Nematoda: Tylenchinae) found associated with grass roots in Aligarh, India. Nematologica **4**: 217-222.

SIDDIQI, M.R. (1961). Studies on Tylenchorhynchus spp. (Nematoda : Tylenchida) from India. Z. Parasitkde. **21**: 46-64.

SIDDIQI, M.R. (1961a). Studies on species of Criconematinae (Nematoda : Tylenchida) from India. Proc. Helm. Soc. Washington **28**: 19-34.

SIDDIQI, M.R. (1963). Four new species in the subfamily Tylenchinae (Nematoda) from North India. Z. Parasitkde. **23**: 397-404.

SIDDIQI, M.R. (1963a). Four new species of the genus Tylenchus Bastian, 1865 (Nematoda) from North India. Z. Parasitkde. **23**: 170-180.

SIDDIQI, M.R. (1966). Hirschmanniella nana n.sp. and H. magna n.sp. (Nematoda : Pratylenchidae) from India. Proc. Helm. Soc. Washington **33**: 173-177.

SIDDIQI, M.R. (1970). On the plant parasitic nematode genera Merlinius gen.n. and Tylenchorhynchus Cobb and the classification of the families Dolichodoridae and Belonolaimidae n.rank. Proc. Helm. Soc. Washington **37**: 68-77.

SIDDIQI, M.R. (1971). Structure of the oesophagus in the classification of the superfamily Tylenchoidea (Nematoda). Indian J. Nematol. **1**; 25-43.

SIDDIQI, M.R. (1972). Merlinius brevidens C.I.H. Description of plant parasitic nematodes. Set 1. No. 8. Farnham Royal UK : Commonwealth Agricultural Bureaux.

SIDDIQI, M.R. (1972a). Two new species of Scutellonema from cultivated soils in Africa with a description of Hoplolaimus aorolaimoides sp.n. from Portugal (Nematoda: Hoplolaiminae). Proc. Helm. Soc. Washington **39**: 7-13.

SIDDIQI, M.R. (1980). The origin and phylogeny of the nematode orders Tylenchida Thorne, 1949 and Aphelenchida n.ord. Helminth Abstr. Ser. B **49**: 143-170.

SIDDIQI, M.R. (1980a). Taxonomy of the plant nematode superfamily Hemicycliophoroidea, with a proposal for Criconematina, new suborder. Revue. Nematol. 3: 179-199.

SIDDIQI, M.R. (1986). Tylenchida. Parasites of plants and insects. Commonwealth Institute of Parasitology, St. Albans, U.K. 645 pp.

SIDDIQI, M.R. & BASIR, M.A. (1959). On some plant parasitic nematodes occurring in South India, with the description of two new species of the genus Tylenchorhynchus Cobb, 1913. Proc. 46th Indian Sci. Cong. Part IV. 35.

SIDDIQI, M.R. & BROWN, K.F. (1964). Helicotylenchus retusus n.sp. (Nematoda : Hoplolaiminae) found around sugarcane roots in Negros Oriental, Philippines. Proc. Helm. Soc. Washington **31**: 209-211.

SIDDIQI, M.R. & GOODEY, J.B. (1963). The status of the genera and subfamilies of the Criconematidae (Nematoda); with a comment on the position of Fergusobia. Nematologica **9**: 363-377.

SIDDIQI, M.R., MUKHERJEE, B. & DASGUPTA, M.K. (1982). Tylenchorhynchus microconus n.sp., T. crassicaudatus leviterminalis n.subsp. and T. coffeae Siddiqi & Basir, 1959 (Nematoda : Tylenchida). Syst. Parasitol. **4**: 257-262.

SIDDIQUI, A.U. & KHAN, E. (1982). Taxonomic studies on Tylenchidae (Nematoda) of India I. Description of five new species of Coslenchus Siddiqi, 1978. Indian J. Nematol. **12**: 291-302.

SIDDIQUI, A.U. & KHAN, E. (1983). Taxonomic studies on Tylenchidae (Nematoda) of India. II. Descriptions of two new species of Cosaglenchus gen.n. along with proposition of a new subfamily Aglenchinae. Indian J. Nematol. **12**: 303-311.

SOUTHEY, J.F. (1978). Plant Nematology. Her Majesty's Stationary Office, GDI, London. 440 pp.

STEINER, G. (1938). Nematodes infesting red spiderlilies. J. Agric. Res. 56: 1-8.

STONE, A.R. (1975). Head morphology of second-stage juveniles of some Heteroderidae (Nematoda : Tylenchoidea). Nematologica **21**: 81-88.

STURHAN, D. (1966). Ueber Verbreitung Pathogenitat und Taxonomie der Nematodenga tung Tylenchorhynchus. Mitt. Biol. Bund. Land. u Frost. Berlin-Dahlem **118**: 82-99.

SULTAN, M.S. & JAIRAJPURI, M.S. (1981). Two new species of the genus Cephalenchus (Goodey, 1962) Golden, 1971 with a key to species. Indian J. Nematol **11**: 165-171.

TAHSEEN, Q., AHMAD, I., BILGRAMI, A.L. & AHMAD, W. (1992). SEM studies on Mononchoides fortidens (Diplogasterida). Nematologica **38**: 296-303.

TARJAN, A.C. (1973). A synopsis of the genera and species in Tylenchorhynchinae (Tylenchoidea, Nematoda). Proc. Helm. Soc. Washington **40**: 123-144.

TAYLOR, A.L. (1936). The genera and species of the Criconematinae, a subfamily of the Anguillulinidae (Nematoda). Trans. Am. micr. Soc. 55: 391-421.

THORNE, G. (1941). Some nematodes of the family Tylenchidae which do not posses a valvular median oesophageal bulb. Great Basin Naturalist **2**: 37-85.

THORNE, G. (1949). On the classification of the Tylenchida, new order (Nematoda : Phasmidia). Proc. Helm. Soc. Washington **16**: 37-73.

THORNE, G. (1955). Fifteen new species of the genus Hemicycliophora with an amended description of H. typica De Man (Tylenchida : Criconematidae). Proc. Helm. Soc. Washington **22**: 1-16.

THORNE, G. (1961). Principles of Nematology. McGraw-Hill Book Co., Inc. New York. 553 pp.

THORNE, G. & MALEK, R.B. (1968). Nematodes of the Northern Great Plains. Part I. Tylenchida Nemata : Secernentea. Brookings, S. Dakota, Agric. Exp. Statn. Bull. **31**: 111 pp.

TIMM, R.W. (1965). A preliminary survey of plant parasitic nematodes of Thailand and Philippines. SEATO Publication, Bangkok. 71 pp.

VAN DEN BERG, E. (1981). Further studies on the genus Hemicycliophora De Man, 1921 in South Africa (Nematoda: Hemicycliophoroidea) with a description of a new species. Phytophylactica **13**: 181-194.

VAN DEN BERG, E. (1984). New and known species of some genera of Criconematidae (Nematoda) from South Africa. Phytophylactica. **16**: 33-48.

VAN DEN BERG, E. (1990). Hemicriconemoides capensis sp.n. and a description of males of Hemicycliophora labiata Colbran, 1960 and Criconema sirgeli Van den Berg & Meyer, 1987 (Nemata : Criconematidae) from South Africa. Revue Nematol. **13**: 361-368.

VAN DEN BERG, E. (1991). New and known Criconemella and Ogma species from northern Natal Coastal Sandy Soils (Criconematinae : Nemata). Phytophylactica **23**: 157-165.

VAN DEN BERG, E. (1992). New Criconematinae (Nemata) from the Carolina area of the Eastern Transvaal, South Africa. Phytophylactica **24**: 253-269.

VARAPRASAD, K.S., KHAN, E. & LAL, M. (1980). Paurodontus soloni sp.n. and P. citri sp.n. (Nematoda : Neotylenchoidea) with a key to the species of Paurodontus Thorne, 1941. Indian J. Nematol. **10**: 182-188.

VOVLAS, N. (1980). Two new sheathoid nematodes (Nematoda : Criconematidae) from the Mediterranean region. Nematol. medit. **8**: 73-79.

VOVLAS, N. (1983). Morphology of Hoplolaimus seinhorsti as seen by scanning electron microscope. Nematol. medit. **11**: 145-149.

VOVLAS, N. (1988). Hemicriconemoides sinensis sp.n. (Nemata : Criconematidae) from China. Revue Nematol. **11**: 25-28.

VOVLAS, N. (1992). Taxonomy of Discocriconemella (Nematoda : Criconematoidea) with a redescription of D. mauritiensis. J. Nematol. **24**: 391-398.

VOVLAS, N. & CHENG, H. (1988). Morpho-anatomy of Tylenchorhynchus leviterminalis from the People's Republic of China. Nematol. medit. **16**: 149-152.

VOVLAS, N., CIANCIO, A. & TORRES, E.C. (1990). Criconematids from Peru with a description of Ogma andense sp.n. Nematol. medit. **18**: 243-252.

WACHEK, F. (1955). Die entoparasitschen Tylenchiden. Parasit. SchrReihe **3**: 1-119.

WASILEWSKA, L. (1965). Tylenchus sandneri sp.n., a new nematode from Poland (Nematoda : Tylenchidae). Bull. Acad. Polon. Sci. Zool. **13**: 87-89.

WILLIAMS, J.R.. (1960). Studies on the nematode soil fauna of sugarcane fields in Mauritius. Mauritius Sugar Industry Research Institute, Occasional Paper No. 3. 30 pp.

WOUTS, W.M. (1973a). A revision of the family Heteroderidae (Nematoda : Tylenchoidea). 1. The family Heteroderidae and its subfamilies. Nematologica. **18**: 439-446.

WOUTS, W.M. (1973b). A revision of the family Heteroderidae (Nematoda : Tylenchoidea). II. The subfamily Meloidoderinae. Nematologica **19**: 279-284.

WU, L.Y. (1969). Three new species of the genus Tylenchorhynchus Cobb, 1913 (Tylenchidae : Nematoda) from Canada. Can. J. Zool. **47**: 563-567.

FIGURES

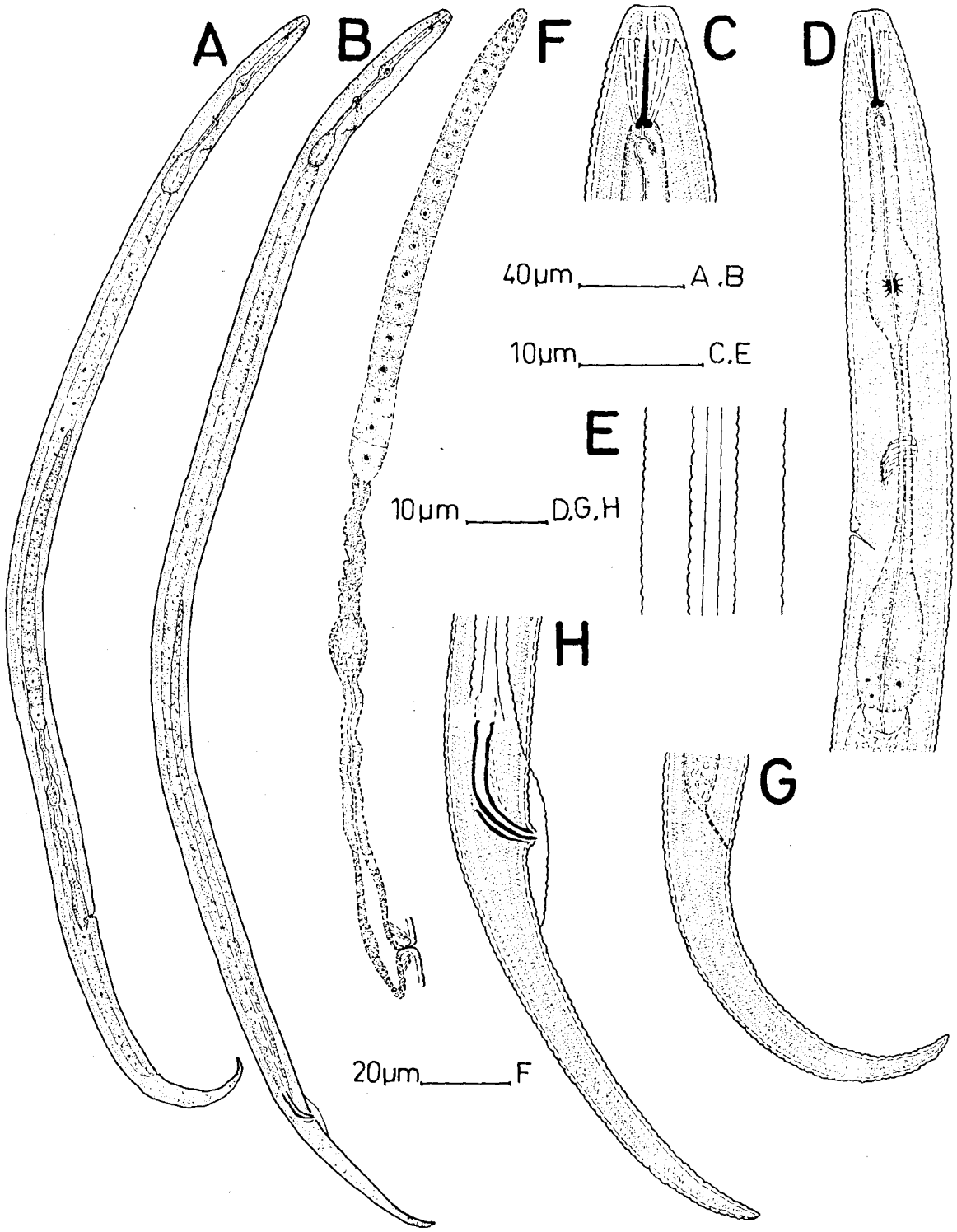

FIG. 1. Filenchus sandneri. A. Entire female; B. Entire male; C. Female head end; D. Female oesophageal region; E. Lateral field; F. Female gonad; G. Female tail end; H. Male tail end.

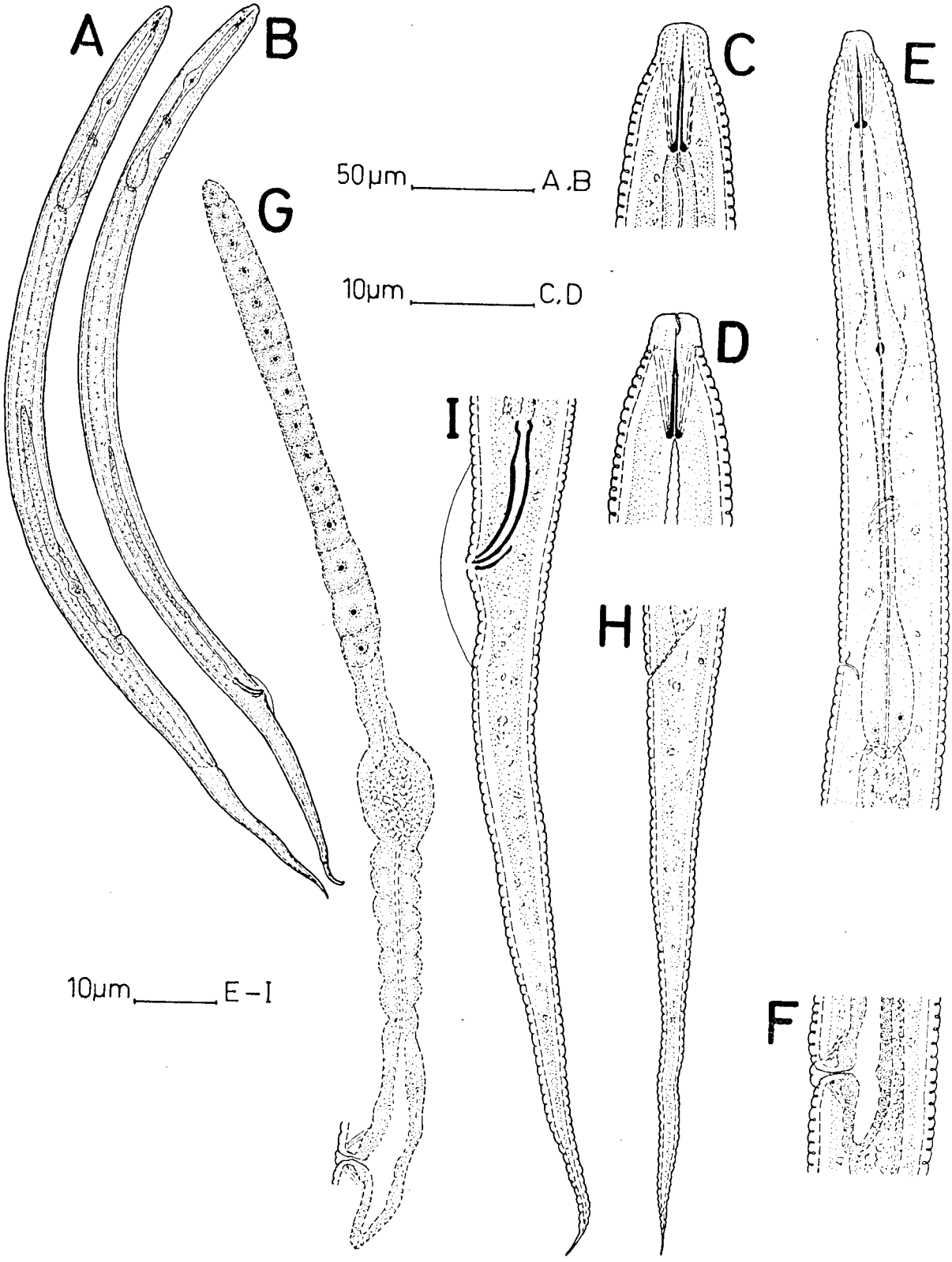

FIG. 2. Malenchus undulatus. A. Entire female; B. Entire male; C & D. Female head ends; E. Female oesophageal region; F. Vulval region; G. Female gonad; H. Female tail end; I. Male tail end.

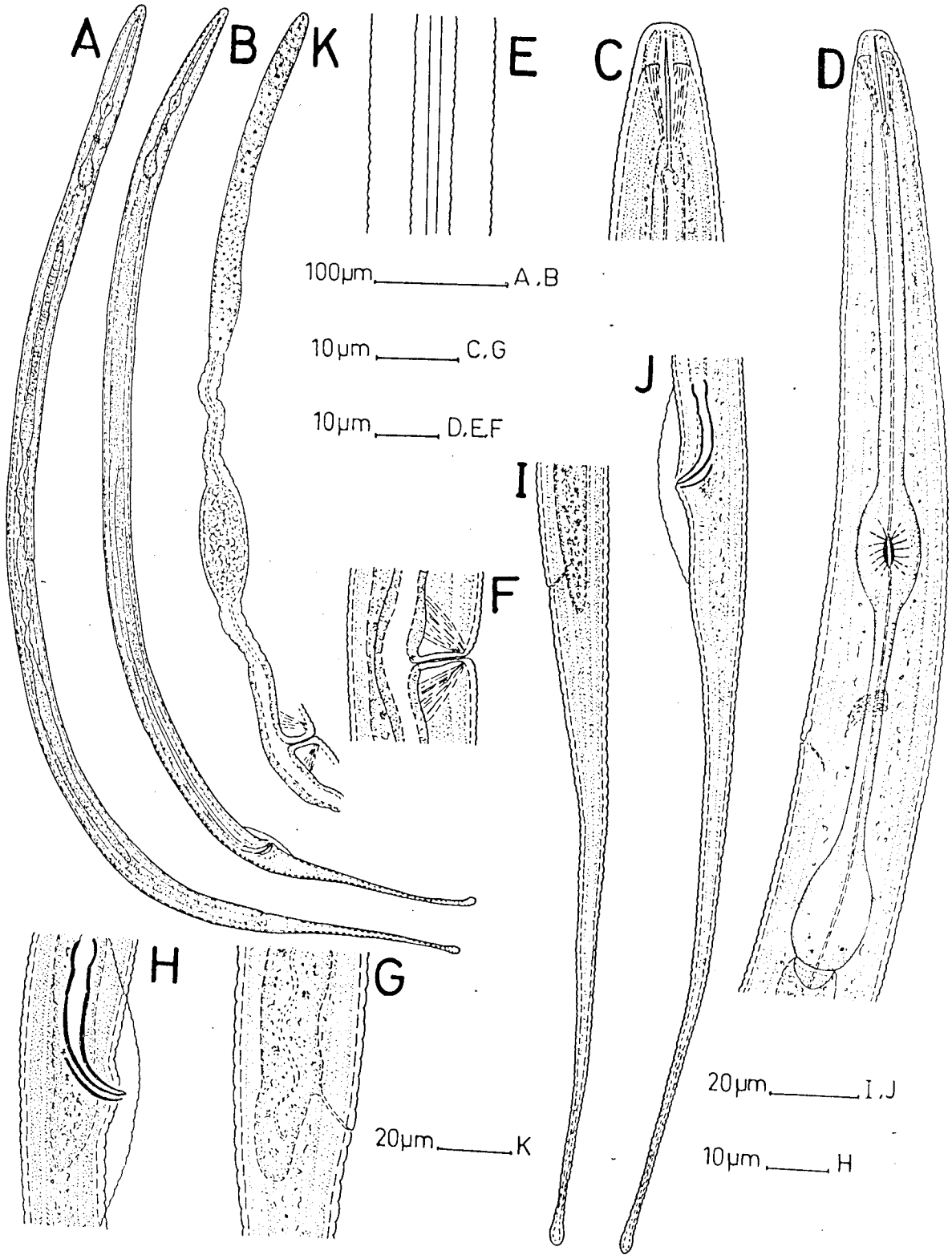

FIG. 3. Psilenchus fasciculii n. sp. A. Entire female; B. Entire male; C. Female head end; D. Female oesophageal region; E. Lateral field; F. Vulval region; G. Female anal region; H. Male cloacal region; I. Female tail end; J. Male tail end; K. Female gonad (anterior branch).

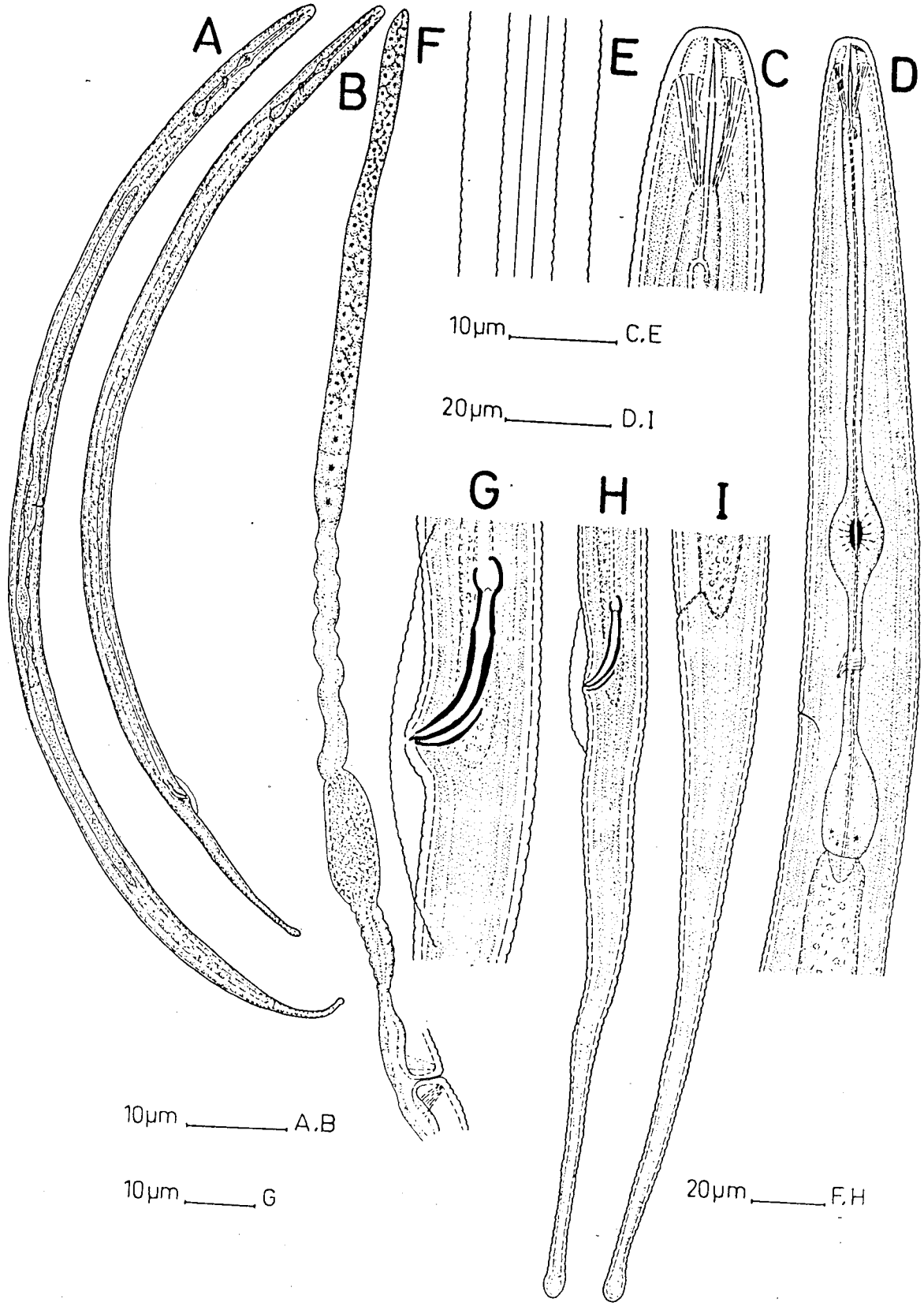

FIG. 4. Psilenchus kumaoensis n. sp. A. Entire female; B.Entire male; C. Female head end; D. Female oesophageal region; E. Lateral field; F. Female gonad (anterior branch); G. Cloacal region; H. Male tail end; I. Female tail end.

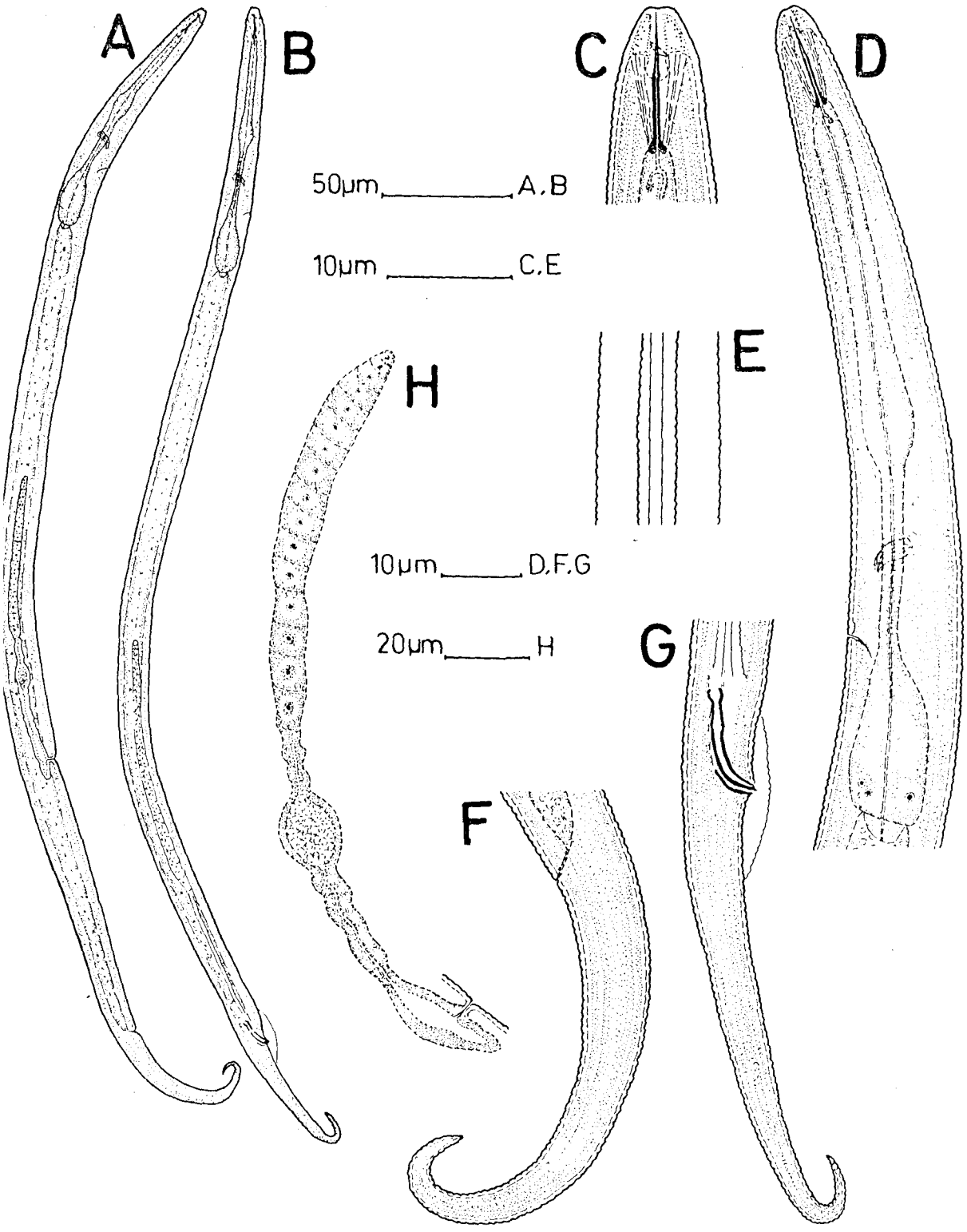

FIG. 5. Boleodorus caricai n. sp. A. Entire female; B. Entire male; C. Female head end; D. Female oesophageal region; E. Lateral field; F. Female tail end; G. Male tail end; H. Female gonad.

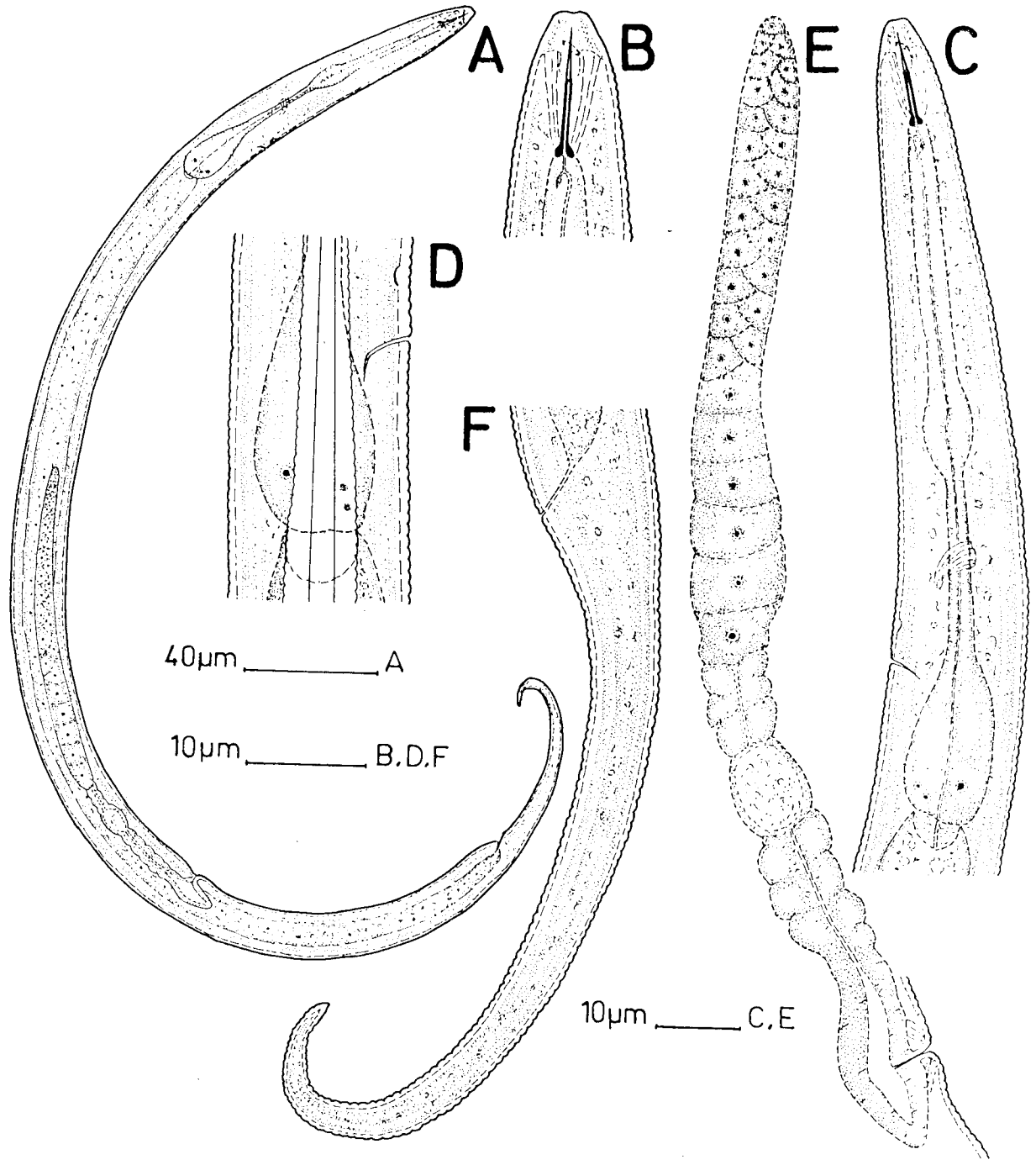

FIG. 6. Boleodorus constrictus n. sp. A. Entire female; B. Female head end; C. Oesophageal region; D. Basal bulb region; E. Female gonad; F. Tail end.

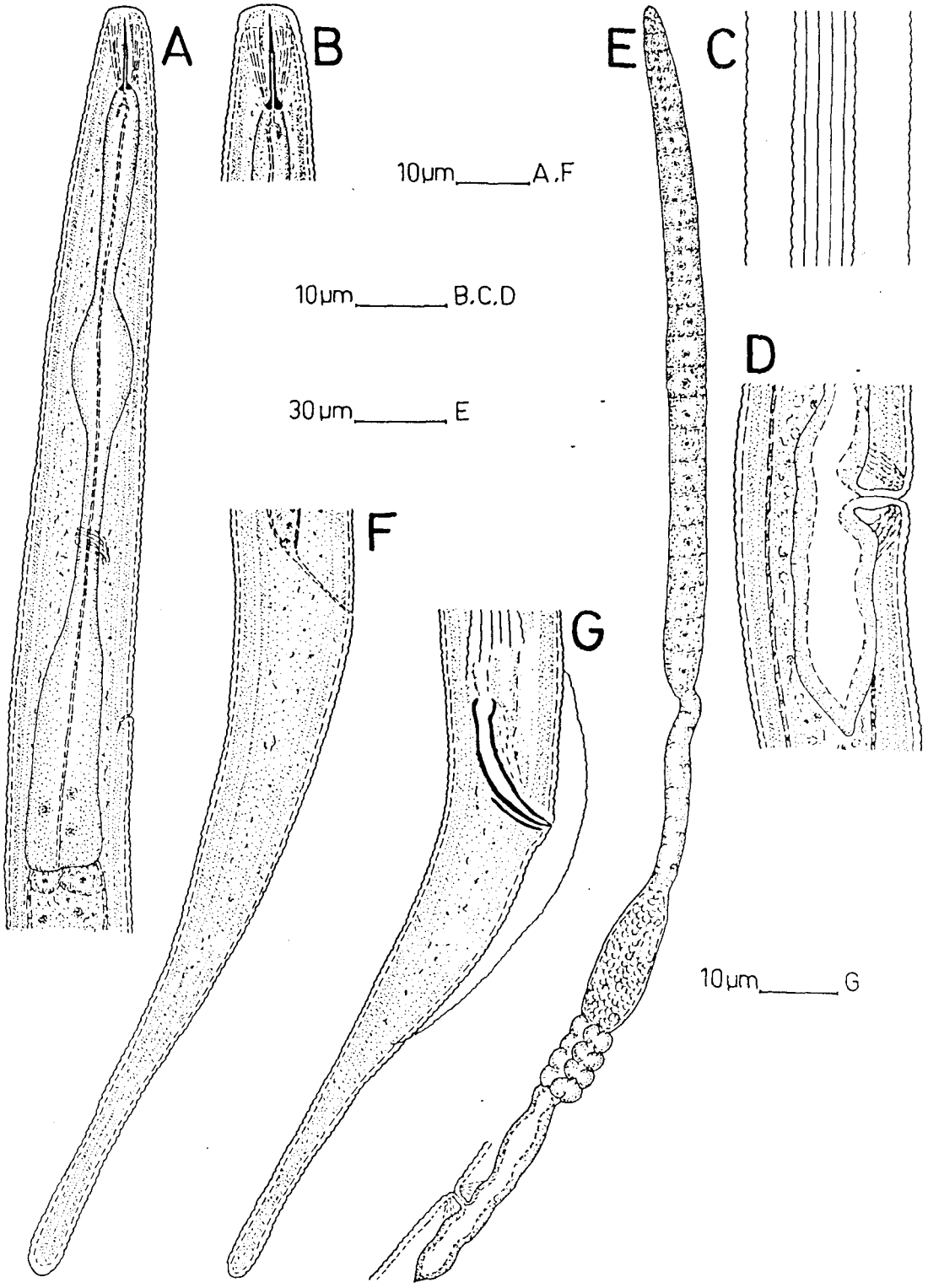

FIG. 7. Ditylenchus domesticus n. sp. A. Female oesophageal region; B. Female head end; C. Lateral field; D. Vulval region showing post-vulval sac; E. Female gonad; F. Female tail end; G. Male tail end.

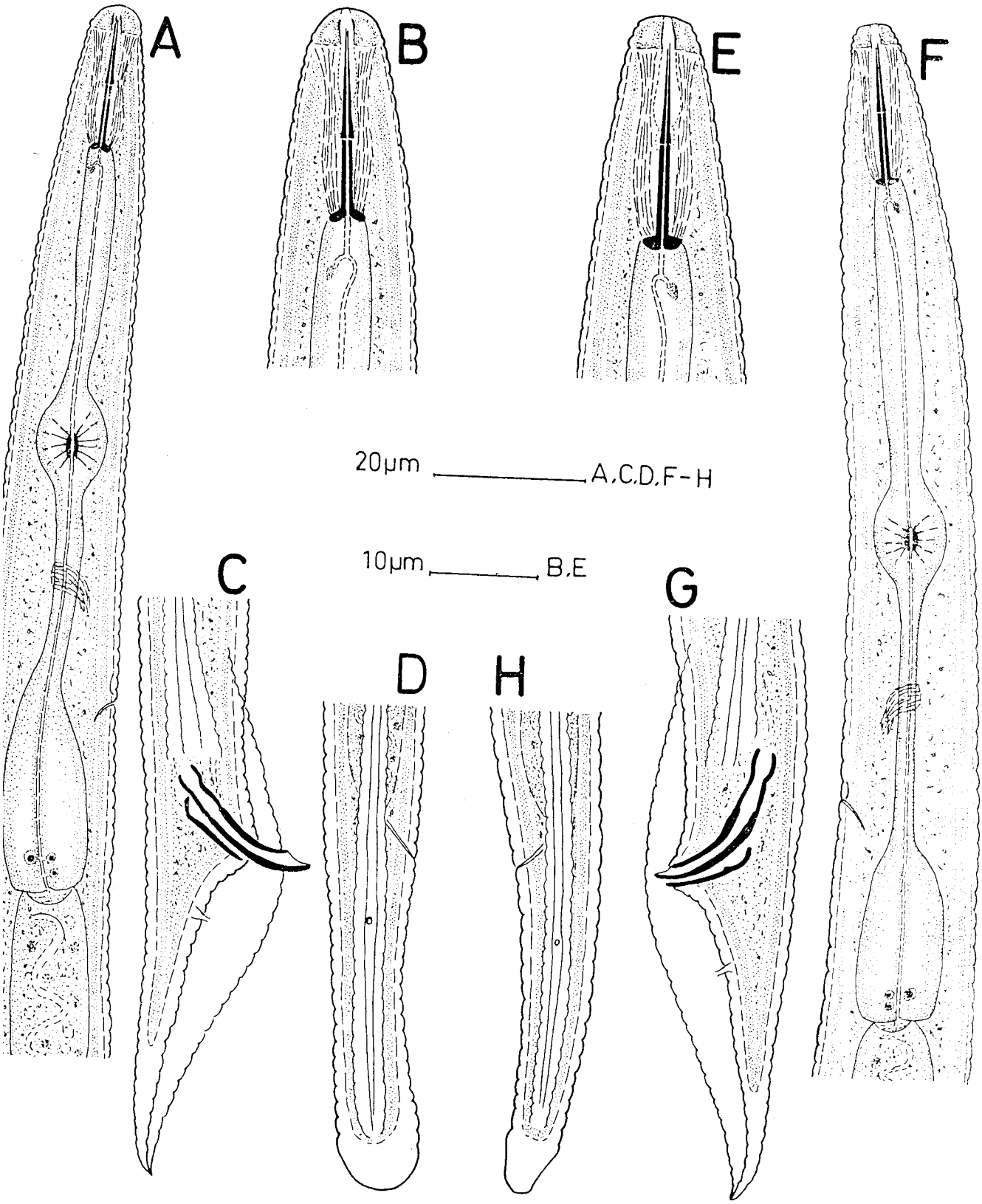

FIG. 8. A-D Tylenchorhynchus leviterminalis. A. Female oesophageal region; B. Female head end; C. Male tail end; D. Female tail end. E-H Tylenchorhynchus mashhoodi. E. Female head end; F. Female oesophageal region; G. Male tail end; H. Female tail end.

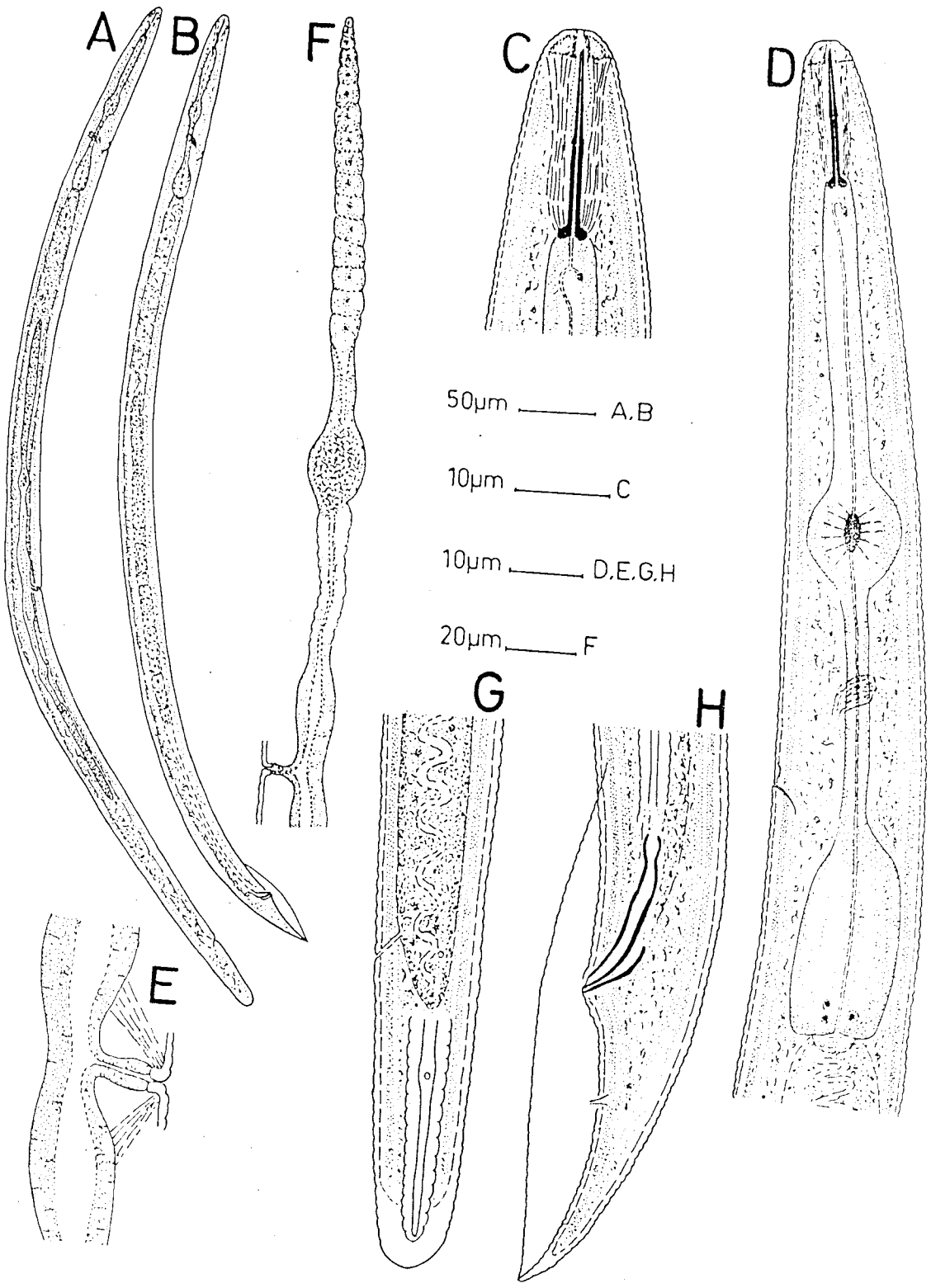

FIG. 9. Tylenchorhynchus rosensis n. sp. A. Entire female; B. Entire male; C. Female head end; D. Female oesophageal region; E. Vulval region; F. Female gonad (anterior branch); G. Female tail end; H. Male tail end.

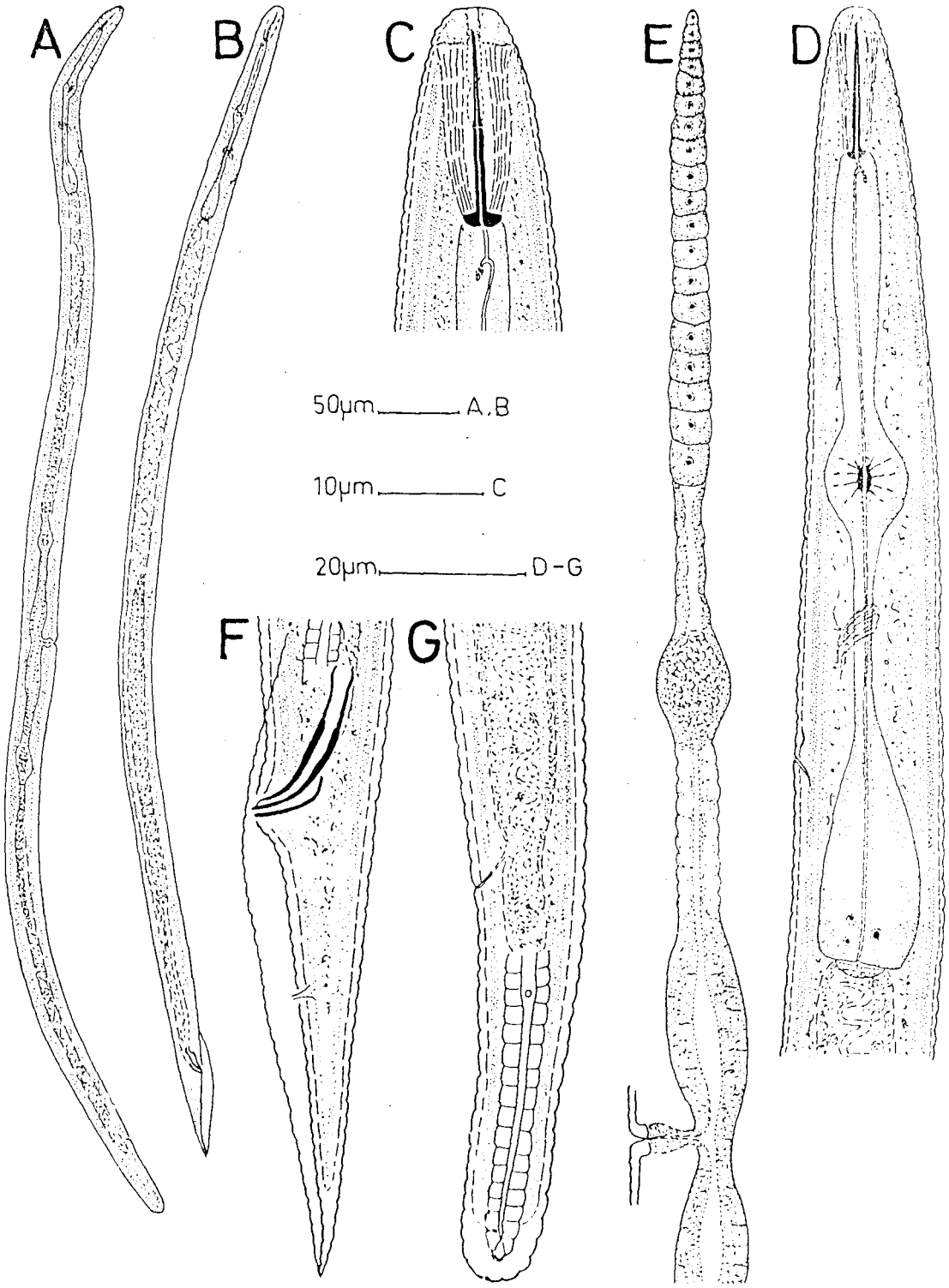

FIG.10 . Tylenchorhynchus cherapunjii n. sp. A. Entire female; B. Entire male; C. Female head end; D. Female oesophageal region; E. Female gonad (anterior branch); F. Male tail end; G. Female tail end.

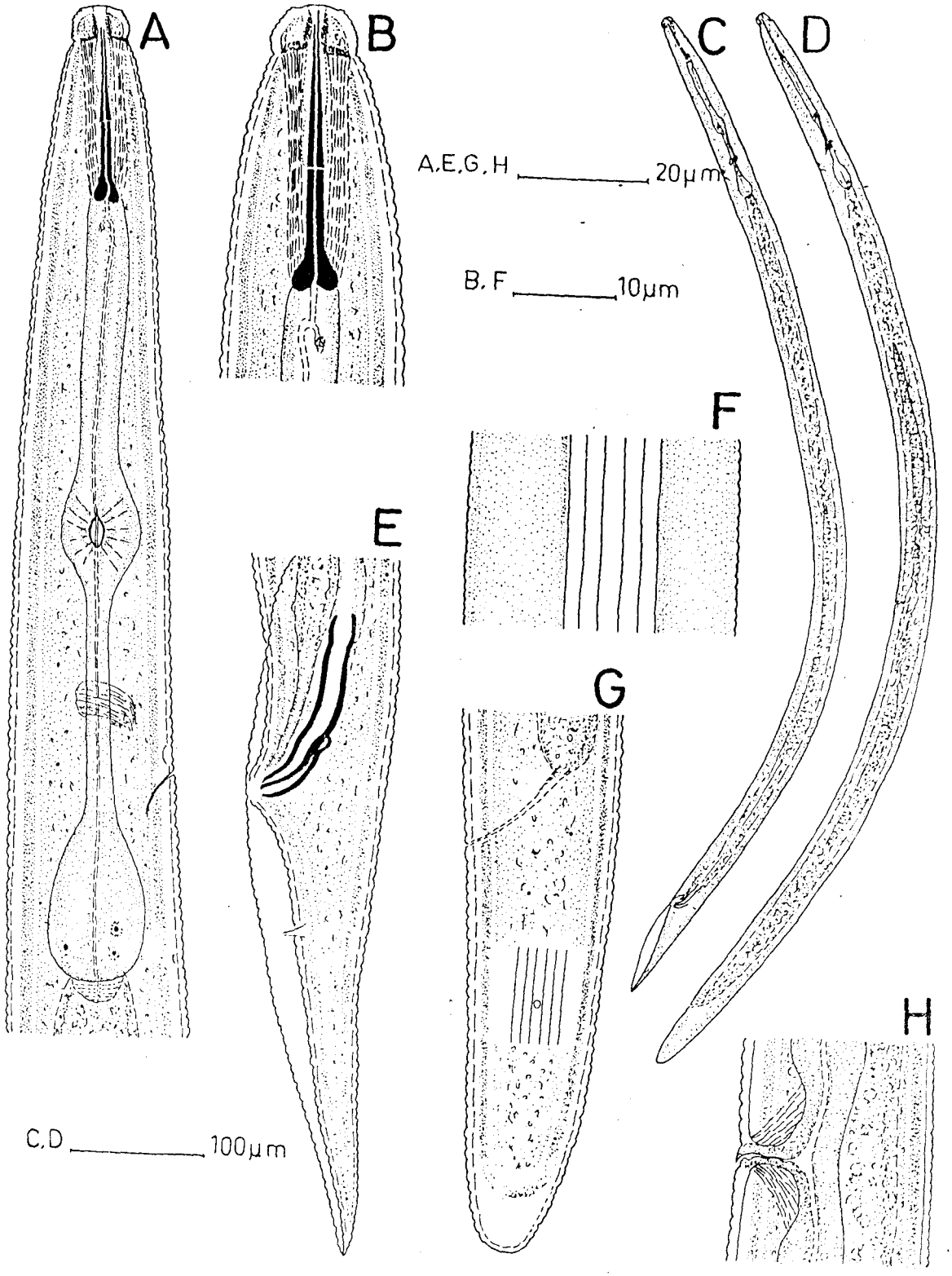

FIG. 11. Merlinius orientalis n. sp. A. Female oesophageal region; B. Female head end; C. Entire male; D. Entire female; E. Male tail end; F. Lateral field; G. Female tail end; H. Vulval region.

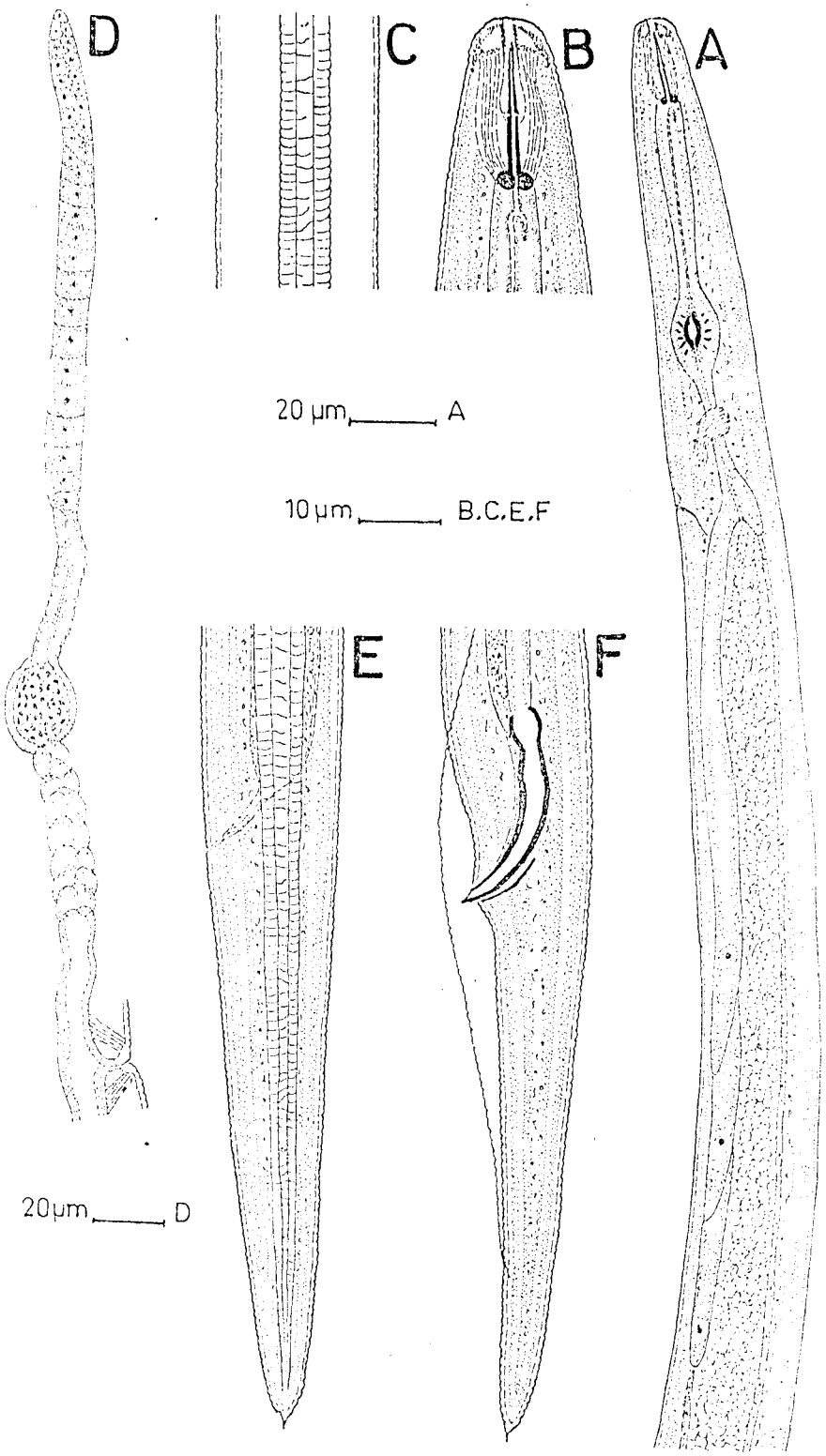

FIG. 12. Hirschmanniella oryzae. A. Female oesophageal region; B. Female head end; C. Lateral field; D. Female gonad (anterior branch); E. Female posterior end; F. Male posterior end.

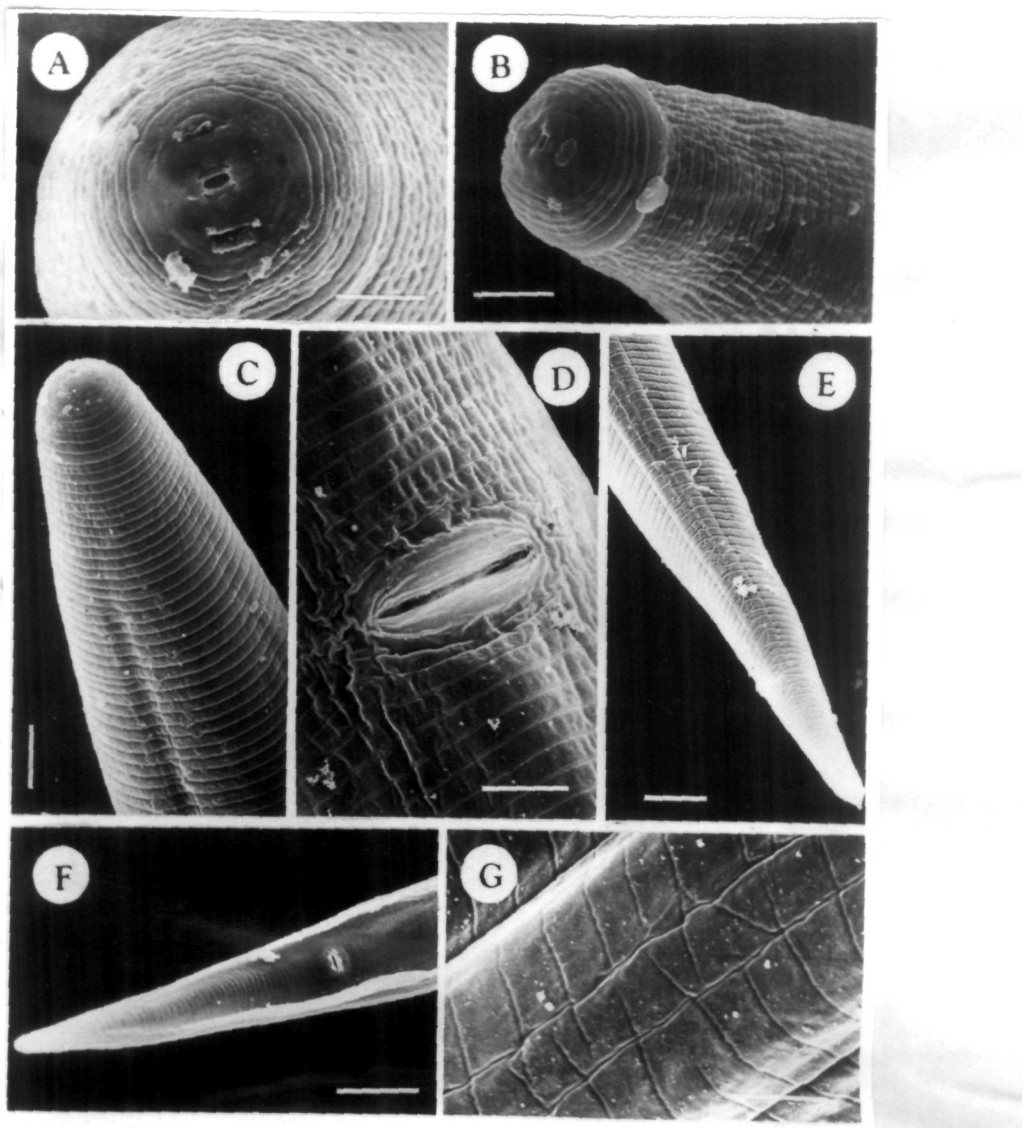

FIG. 13. Hirschmanniella oryzae. A. En face view; B & C. Female anterior ends; D. Vulva; E. Female tail end; F. Male tail end; G. Lateral field at midbody (Scale: Bar= 3 um in A,B,G; 5 um in C,D; 10 um in E; 20 um in F).

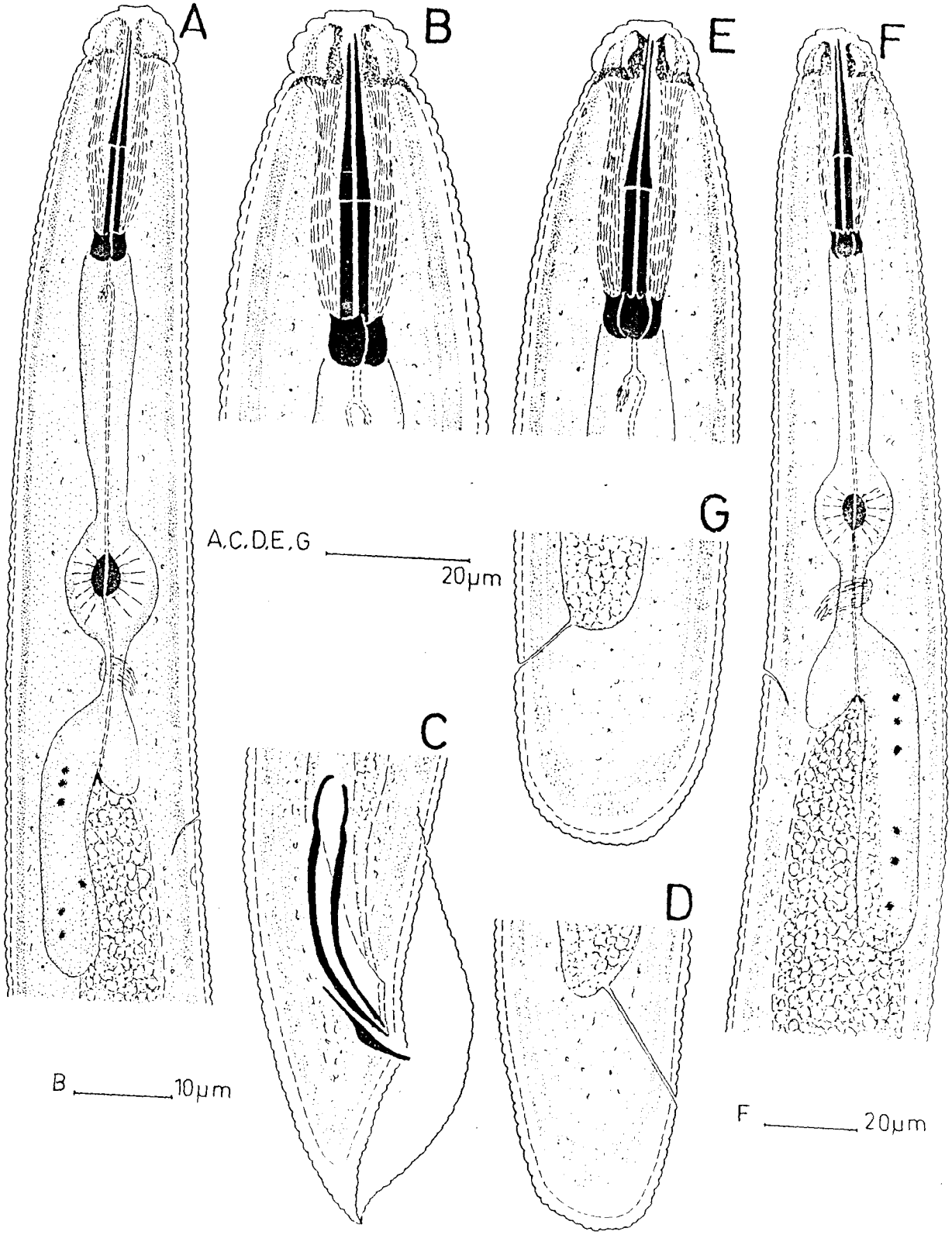

FIG. 14. A-D Hoplolaimus indicus. A. Female oesophageal region; B. Female head end; C. Male tail end; D. Female tail end. E-G Hoplolaimus chambus. E. Head end; F. Oesophageal region; G. Tail end.

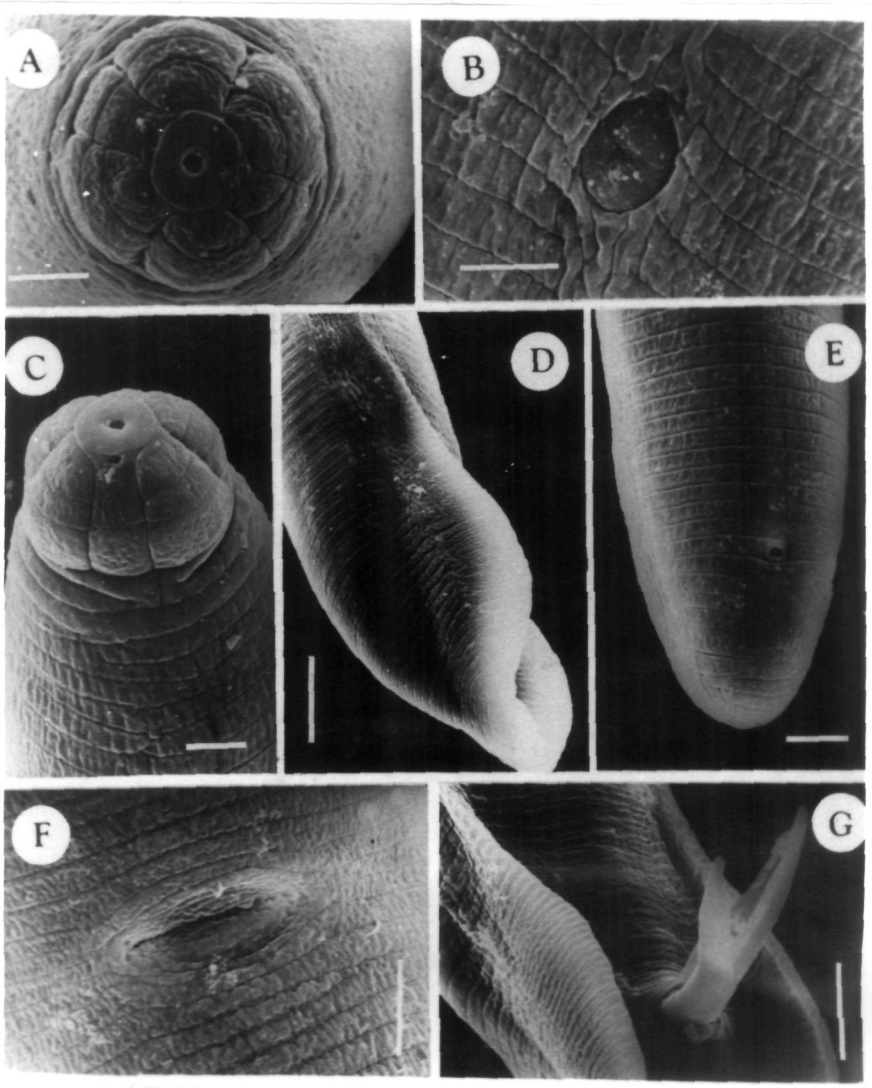

FIG. 15. Hoplolaimus indicus. A. En face view; B. Scutellum; C. Female anterior end; D. Male tail end; E. Female tail end; F. Vulva; G. Male cloacal region (Scale: Bar= 3 um in A,B,F & G; 5 um in C & E; 10 um in D).

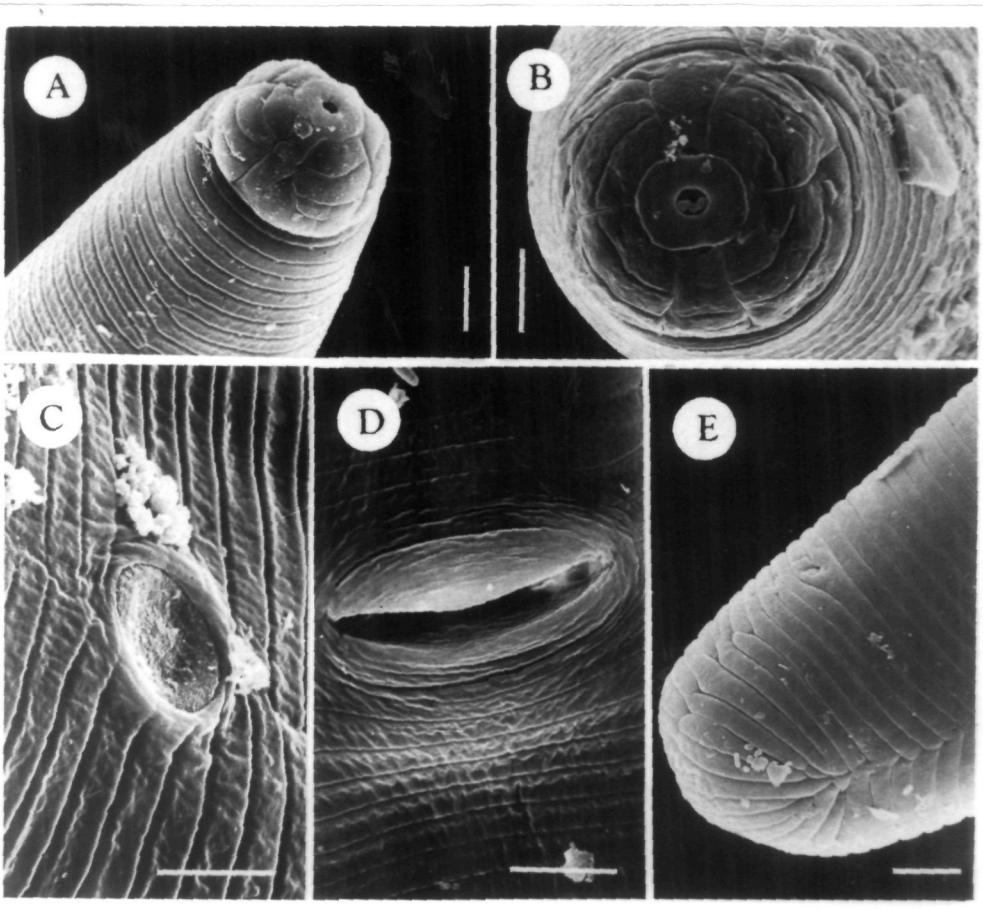

FIG. 16. Hoplolaimus chambus. A. Anterior region; B. En face; C. Scutellum; D. Vulva; E. Tail (Scale: Bar= 5 um in A & D; 4 um in B; 3 um in C; 10 um in E).

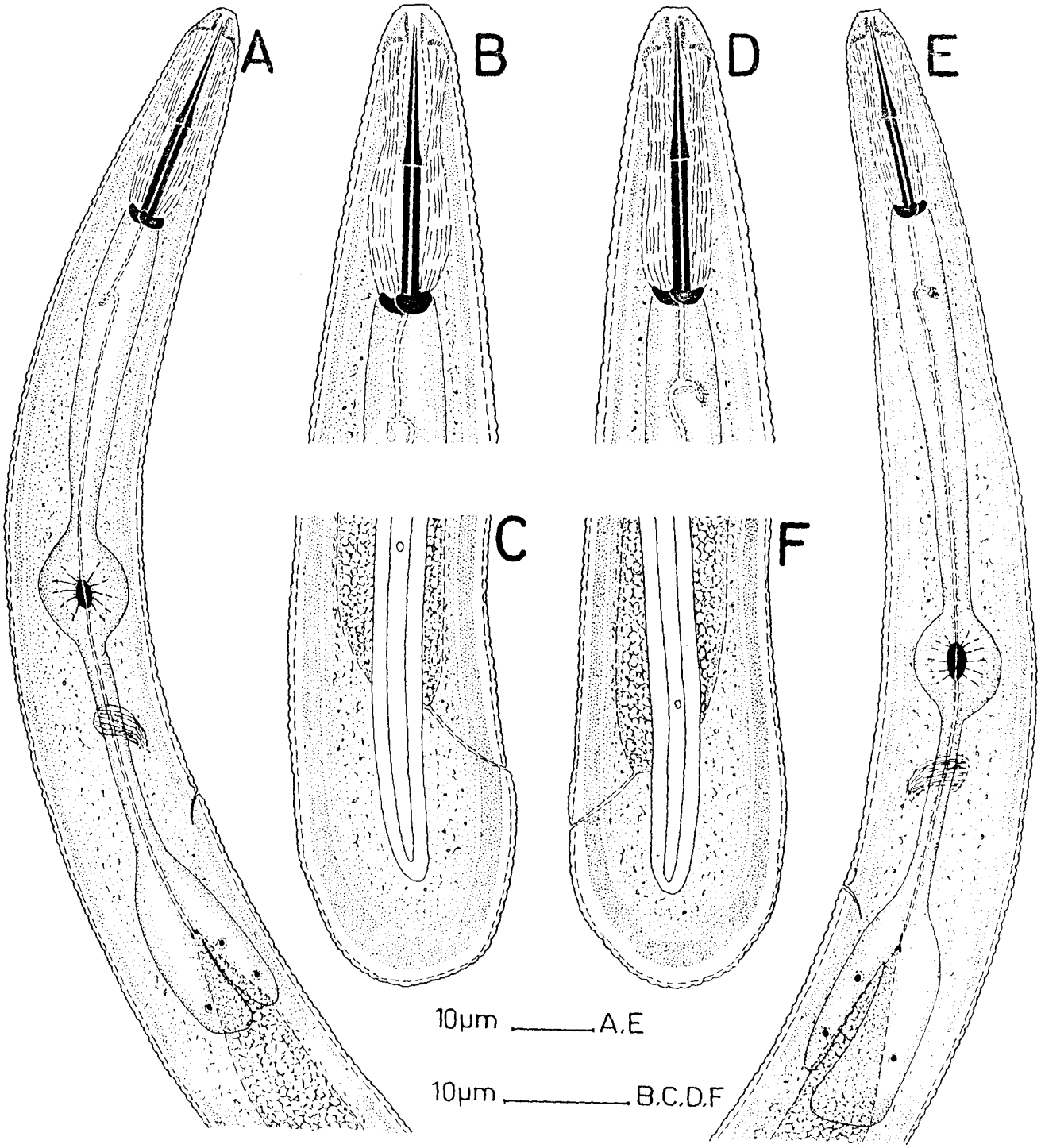

FIG. 17. A-C Helicotylenchus incisus. A. Oesophageal region; B. Head end; C. Tail end. D-F Helicotylenchus retusus. D. Head end; E. Oesophageal region; F. Tail end.

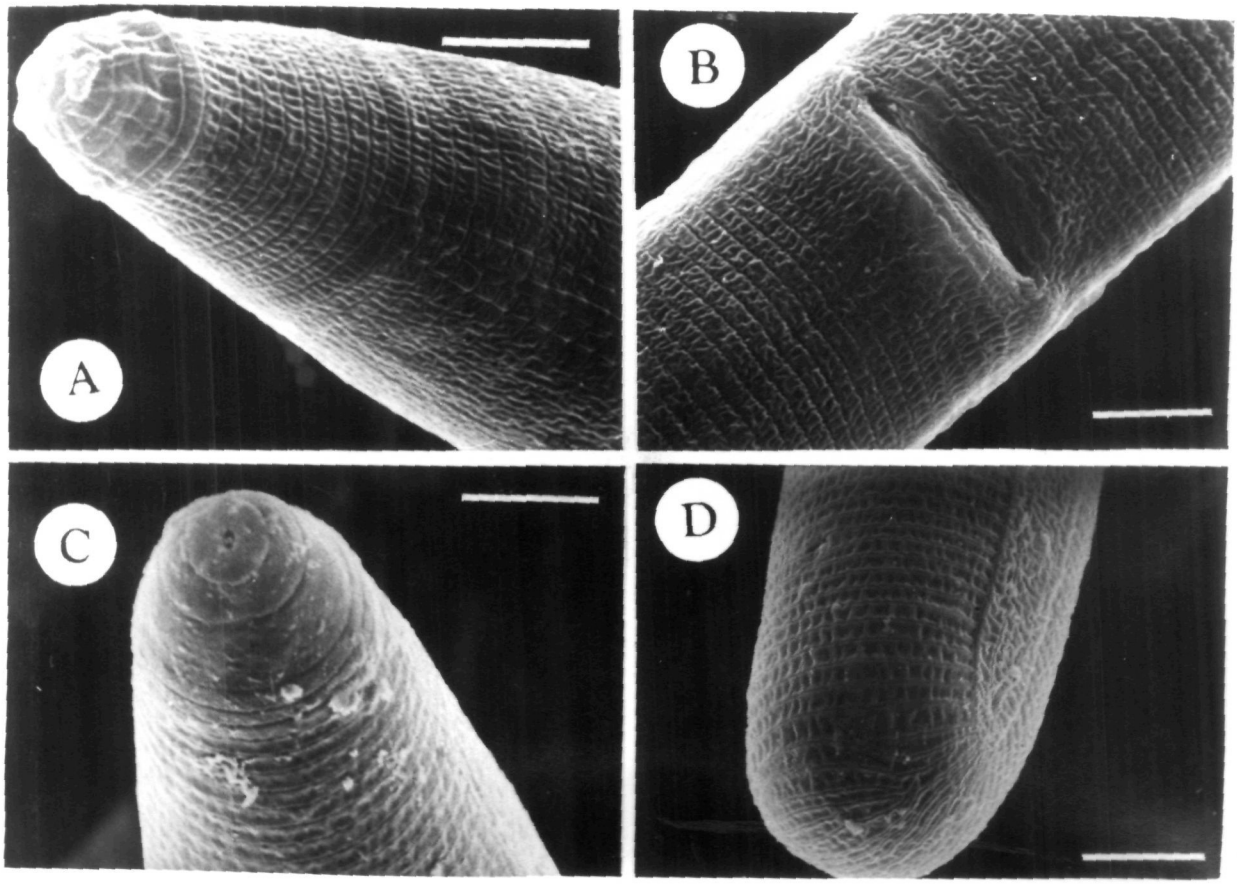

FIG. 18. A & B Helicotylenchus retusus. A. Anterior end; B. Vulva. C & D Helicotylenchus incisus. C. Anterior end; D. Tail end (Scale: Bar= 3 um in A & C; 5 um in B & D).

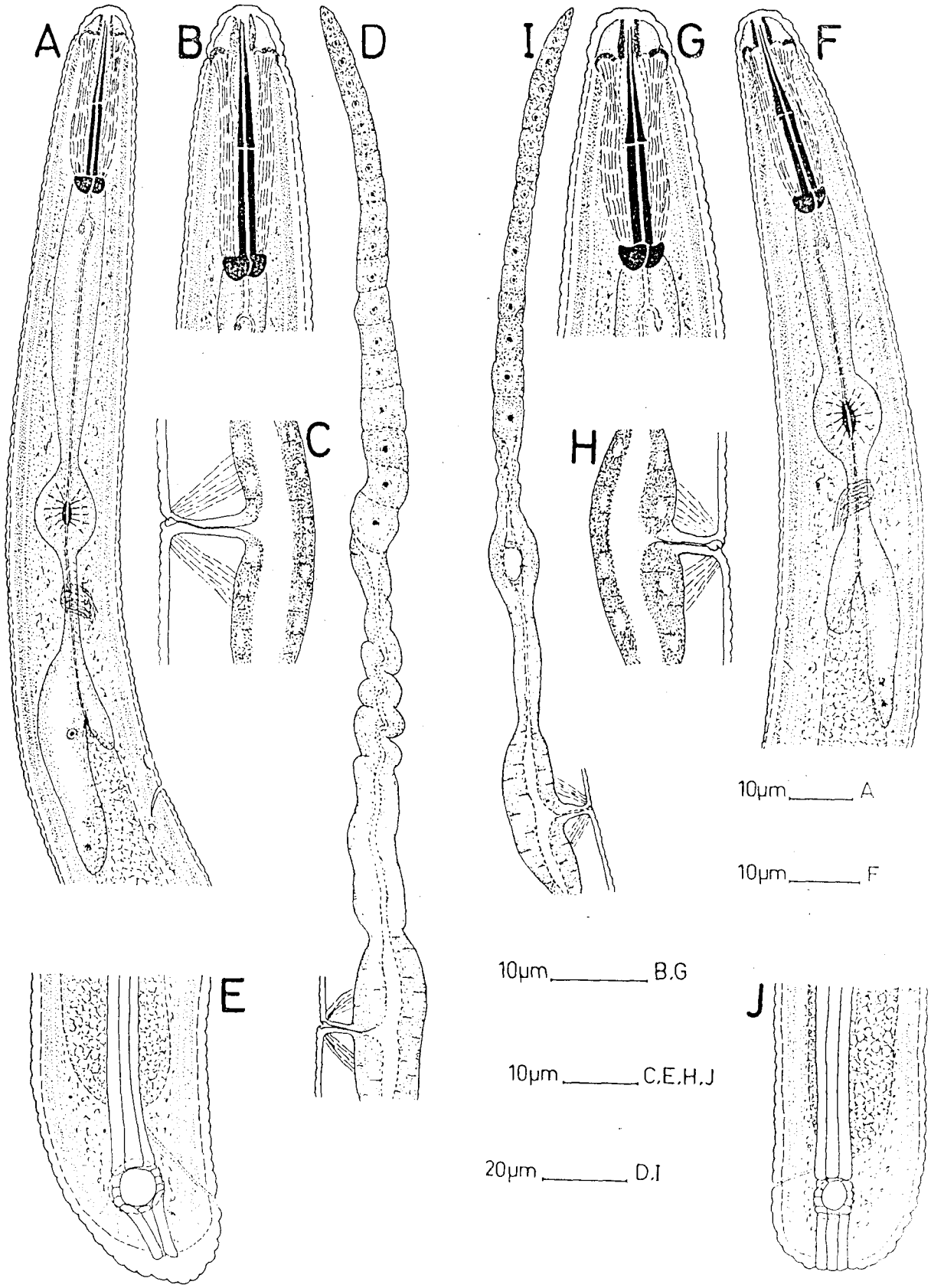

FIG. 19. A-E Scutellonema brevistylatum. A. Oesophageal region; B. Head end; C. Vulval region; D. Gonad (anterior branch); E. Tail end. F-J Scutellonema bambusai n. sp. F. Oesophageal region; G. Head end; H. Vulval region; I. Gonad (anterior branch); J. Tail end.

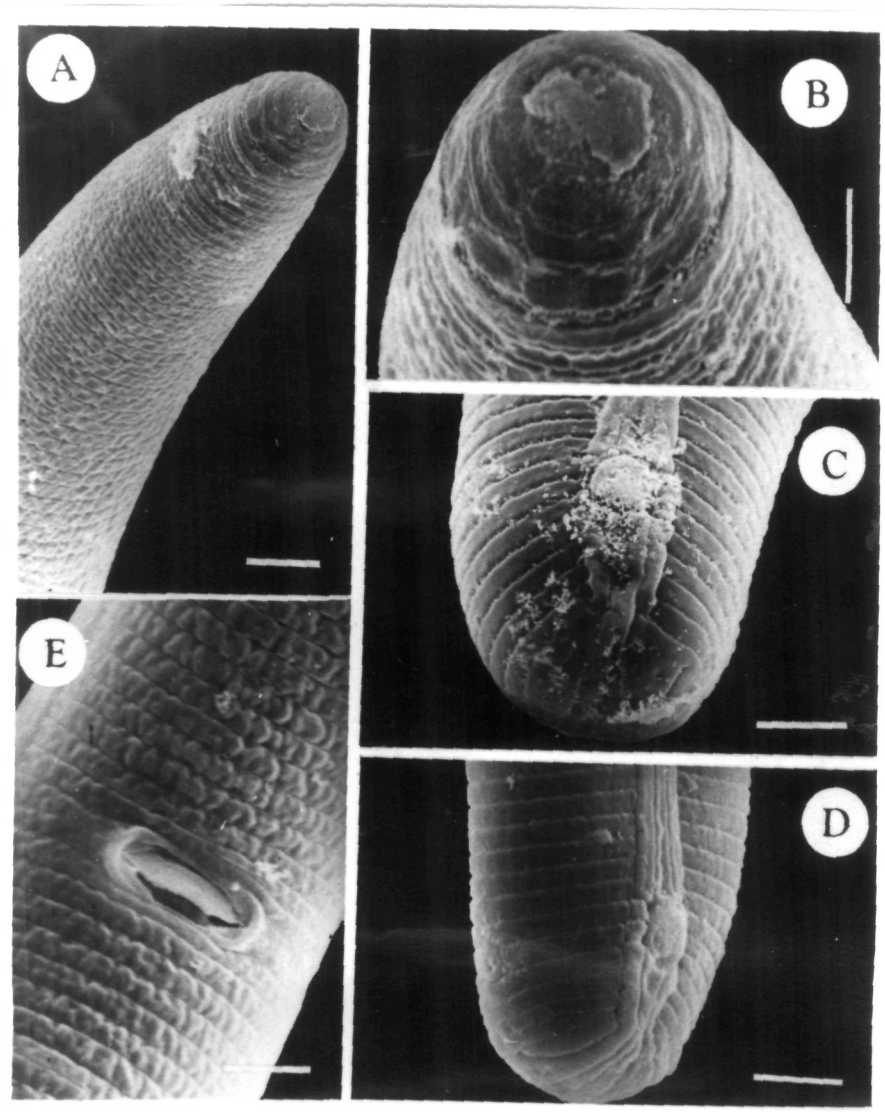

FIG. 20. Scutellonema bambusai n. sp. A. Anterior end; B. En face view; C & D. Posterior ends; E. Vulva (Scale: Bar= 5 um in A,C-E; 3 um in B).

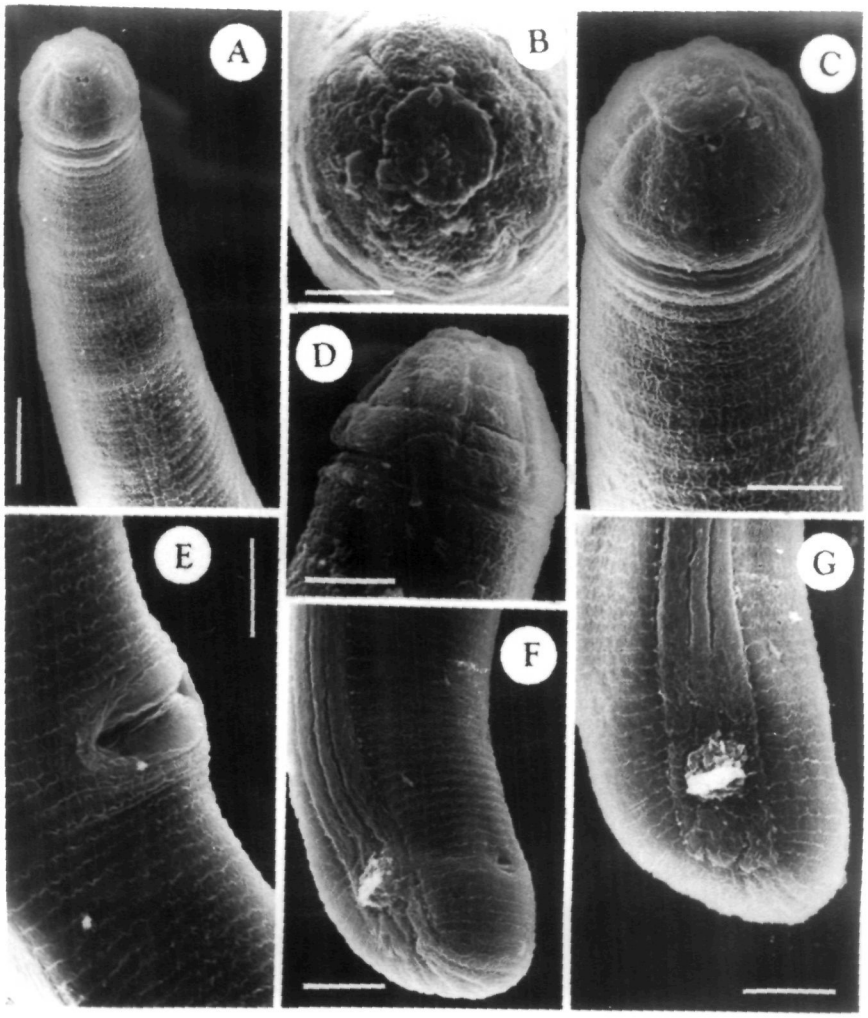

FIG. 21. Scutellonema brevistylatum. A & C. Female anterior ends; B. En face view; D. Head end; E. Vulva; F & G. Tail ends (Scale: Bar= 6 um in A; 10 um in B; 3 um in C; 8 um in D; 5 um in E-G).

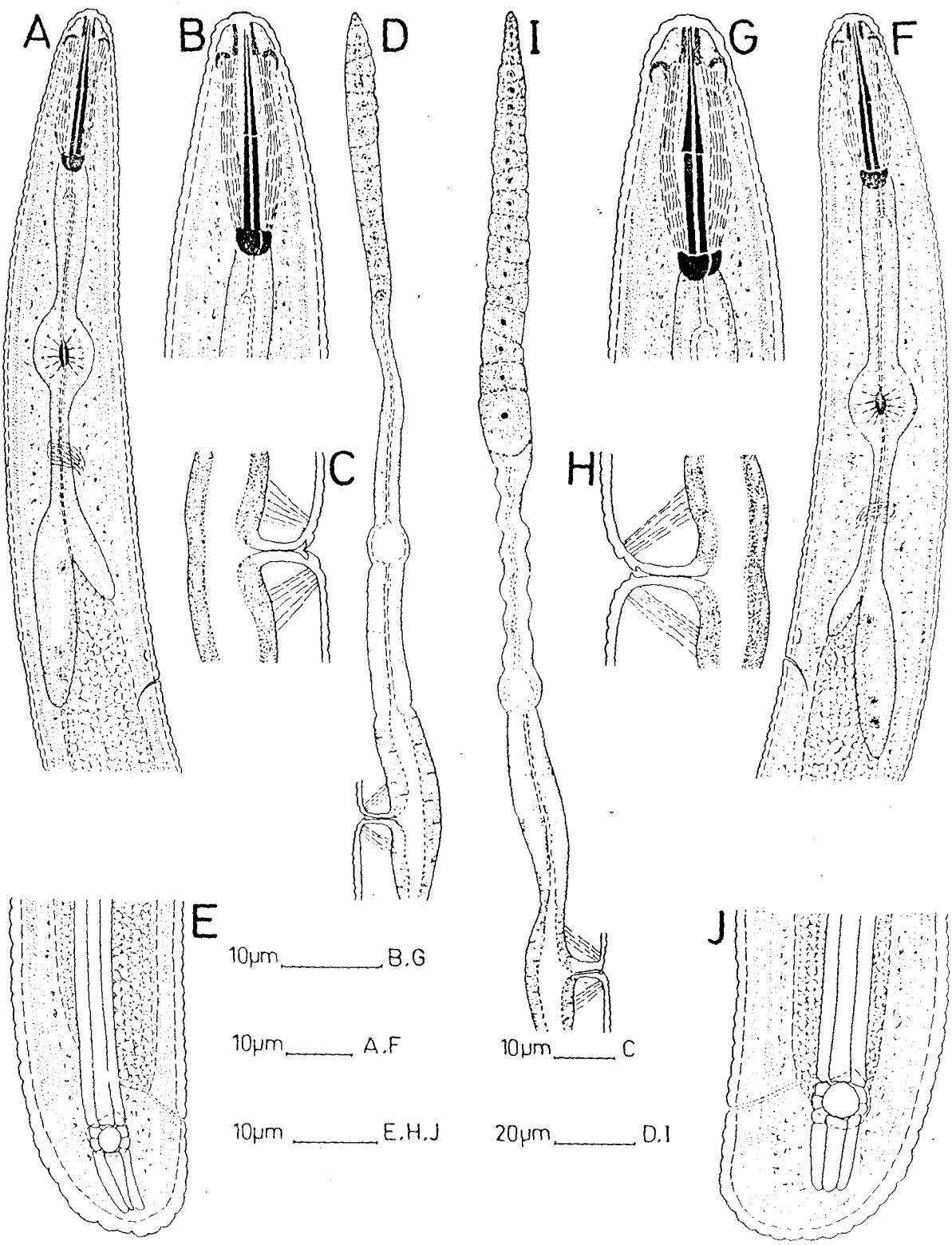

FIG. 22. A-E Scutellonema cephalodiscus n. sp. A. Oesophageal region; B. Head end; C. Vulval region; D. Gonad (anterior branch); E. Tail end. F-J Scutellonema shamimi n. sp. F. Oesophageal region; G. Head end; H. Vulval region; I. Gonad (anterior branch); J. Tail end.

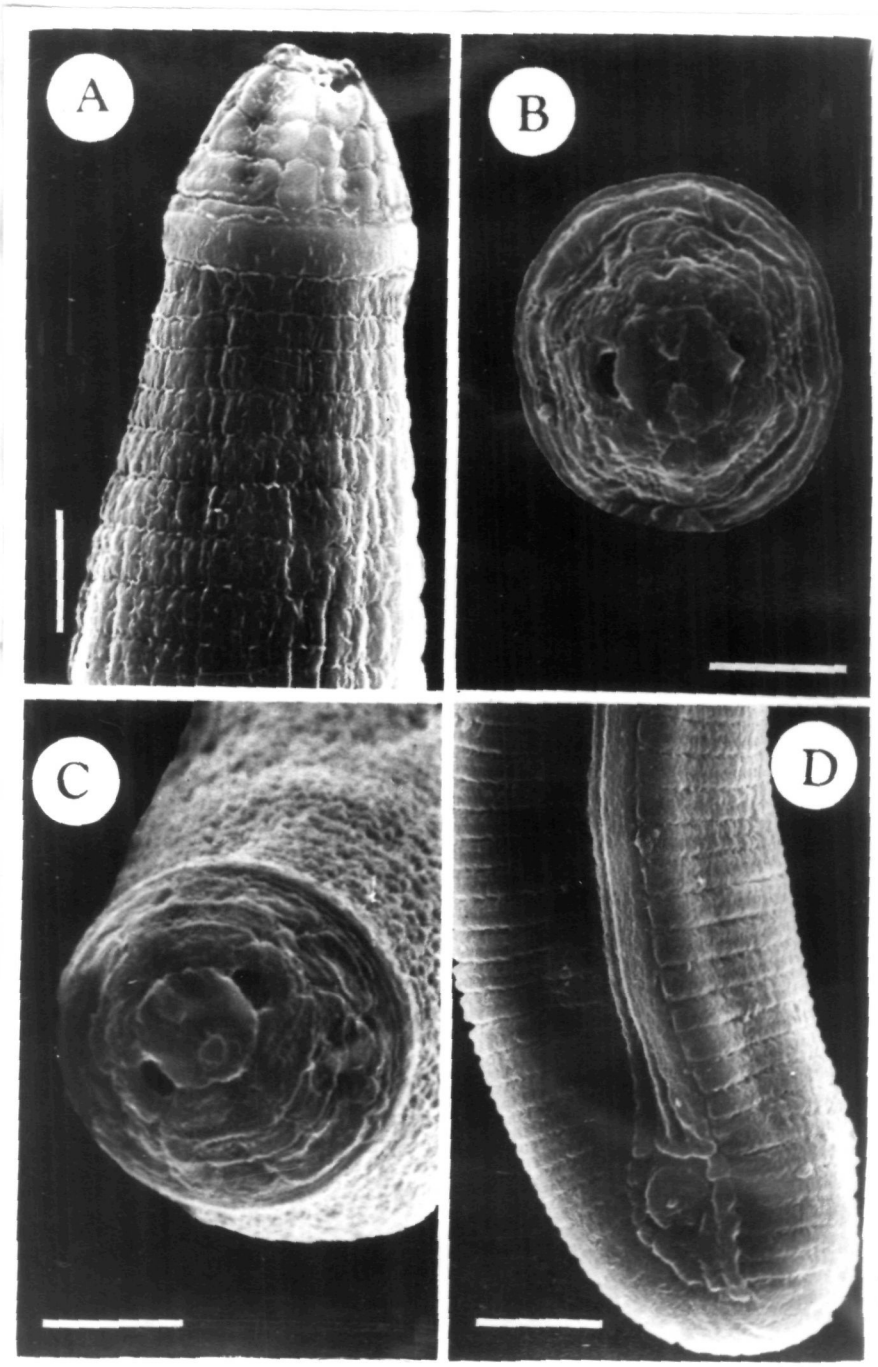

FIG. 23. Scutellonema cephalodiscus n. sp. A. Anterior end; B & C. En face views; D. Posterior end (Scale: Bar= 3 um in A-C; 5 um in D).

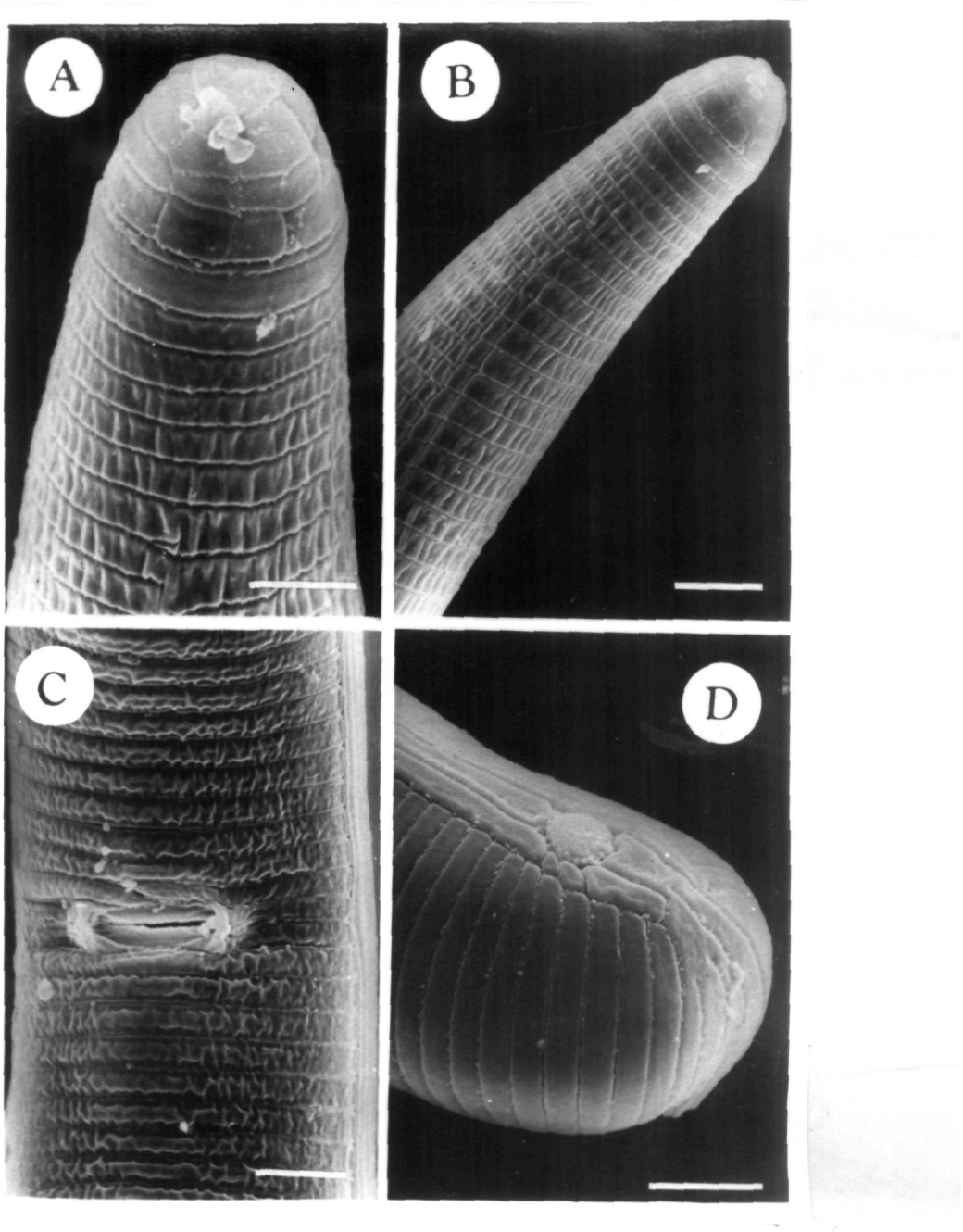

FIG. 24. Scutellonema shamimi n. sp. A & B. Anterior ends; C. Vulva; D. Tail end (Scale: Bar= 3 um in A; 5 um in B-D).

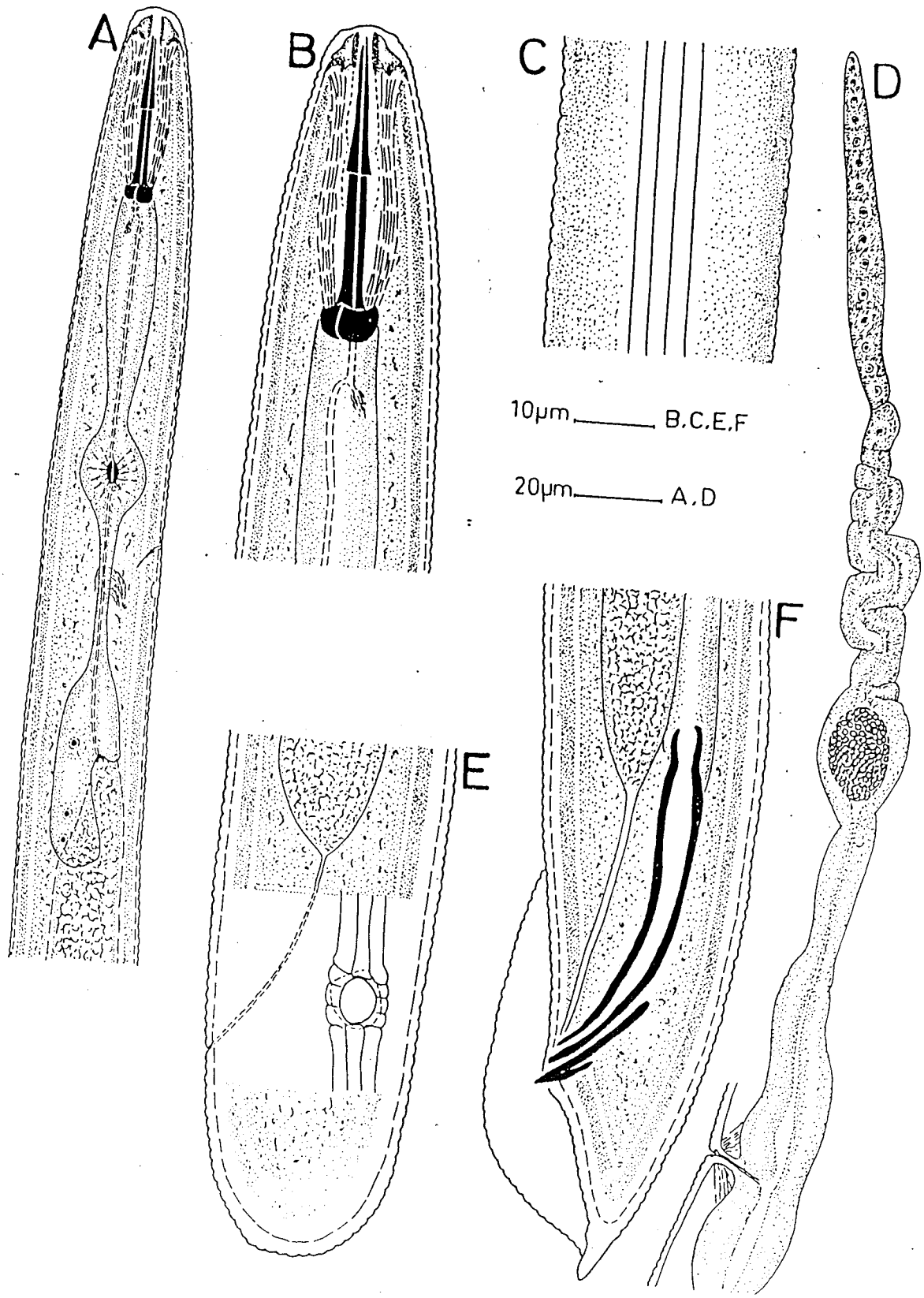

FIG. 25. Scutellonema grande. A. Female oesophageal region; B. Female head end; C. Lateral field; D. Female gonad (anterior branch); E. Female tail end; F. Male tail end.

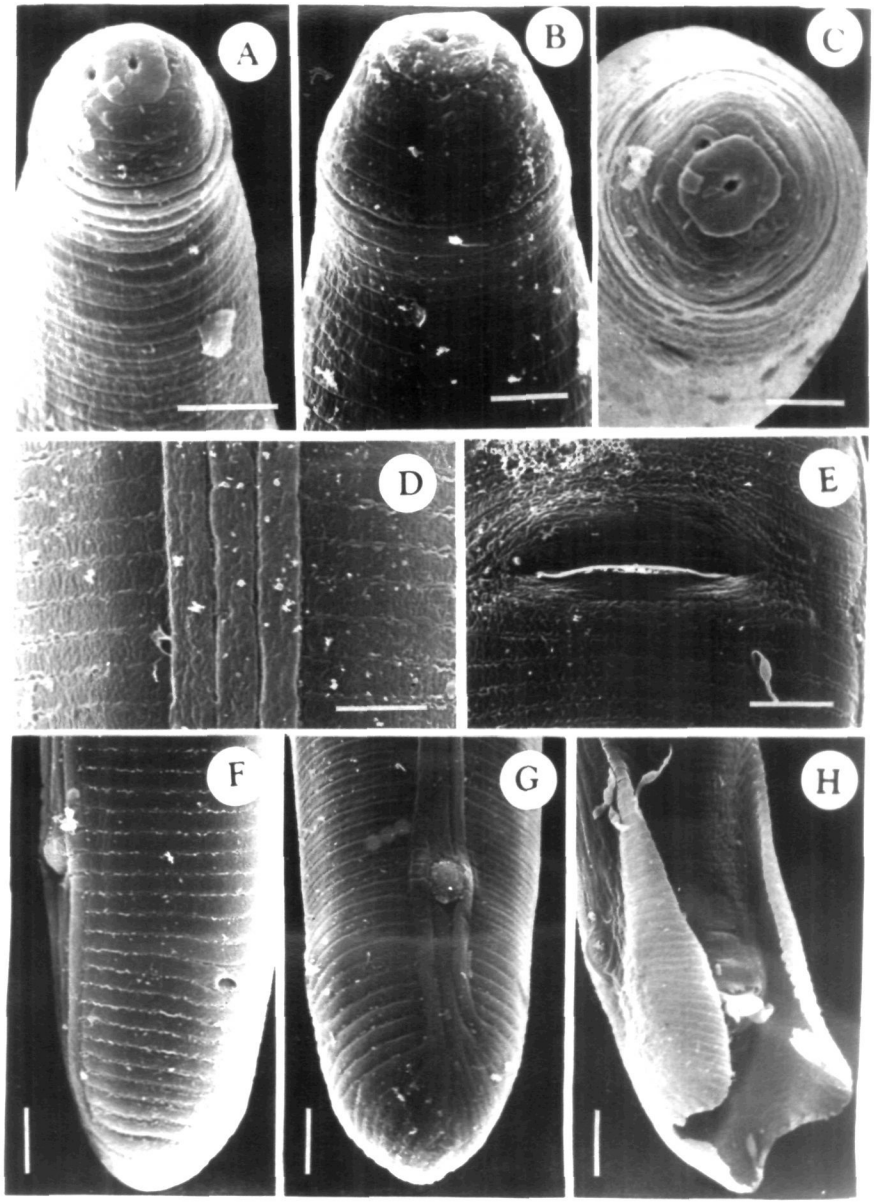

FIG. 26. Scutellonema grande. A & B. Female anterior end; C. En face view; D. Lateral field at midbody; E. Vulva; F & G. Female tail ends; H. Male tail end (Scale: Bar= 5 um in A,D-H; 3 um in B & C).

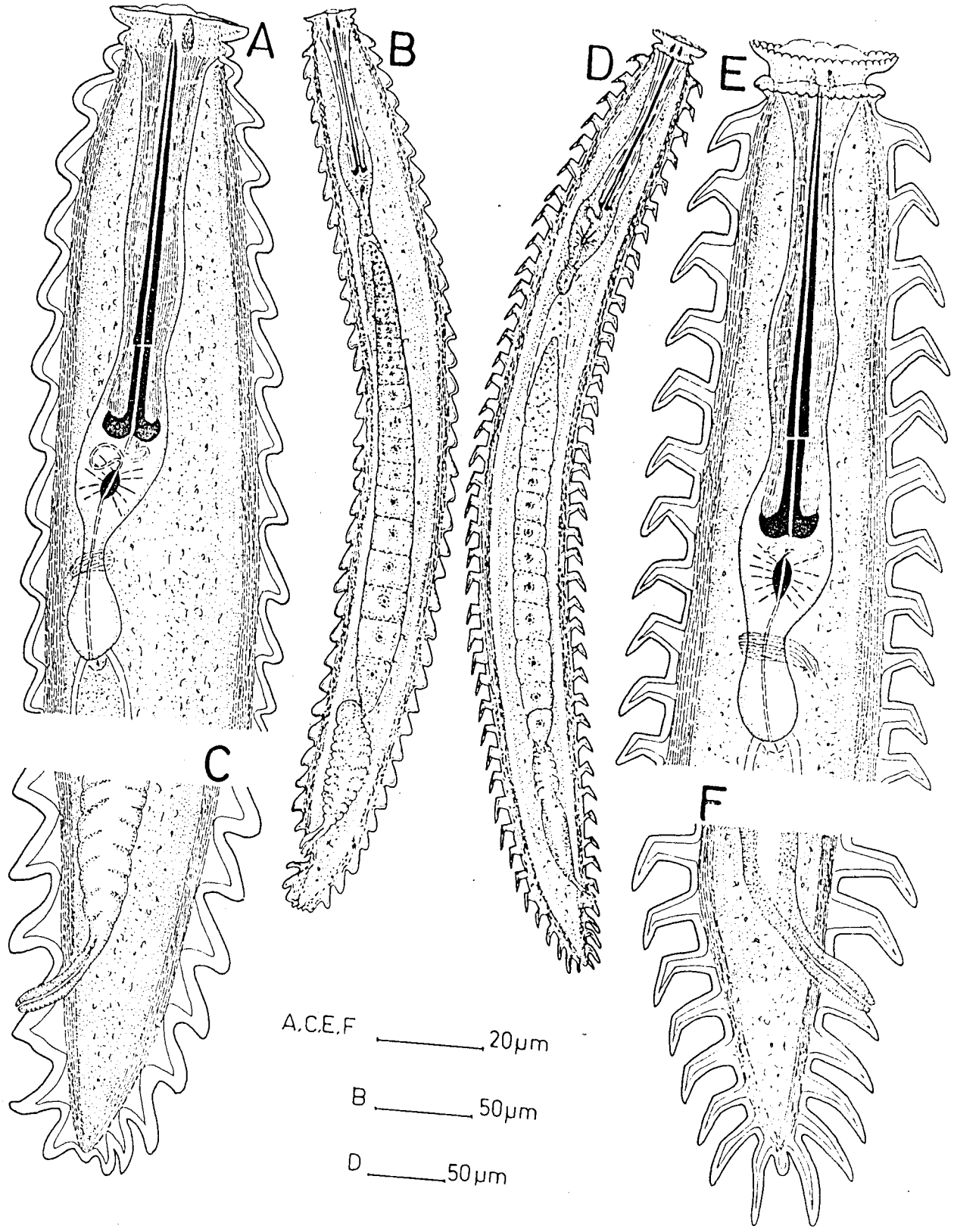

FIG. 27. A-C Criconema aberrans. A. Oesophageal region; B. Entire female; C. Tail end. D-F Ogma civellae. D. Entire female; E. Oesophageal region; F. Tail end.

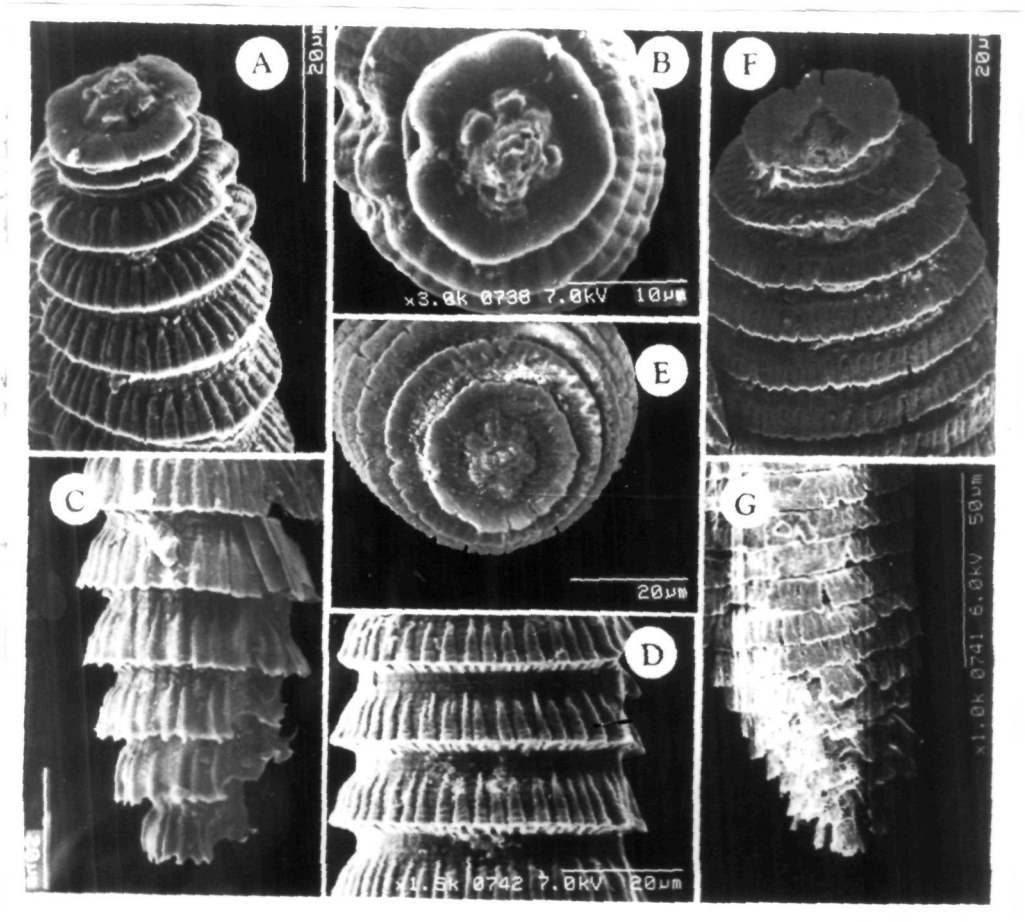

FIG. 28. A-D Criconema aberrans. A. Anterior end; B. En face view; C. Tail end; D. Ornamentation on midbody; E-G Ogma civellae E. En face view; F. Anterior end; G. Posterior end.

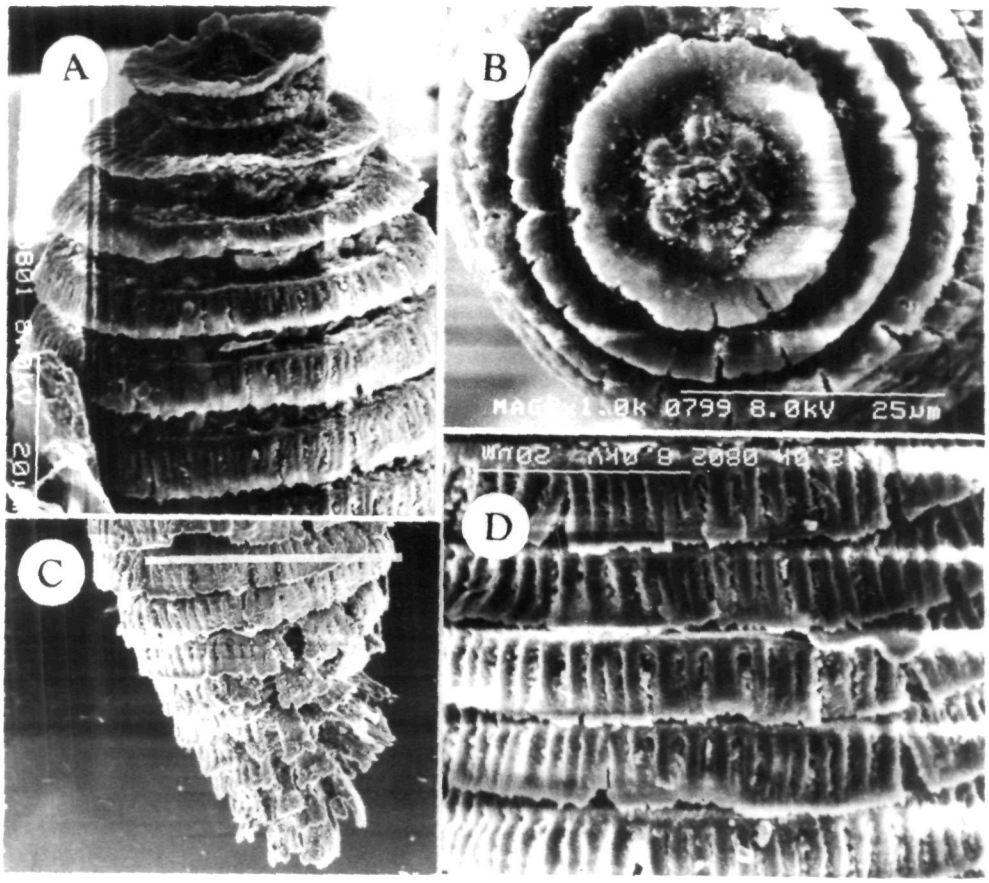

FIG. 29. Ogma civellae. A. Female anterior end; B. En face view; C. Posterior end; D. Spines on midbody (Scale: Bar= 40 um in C).

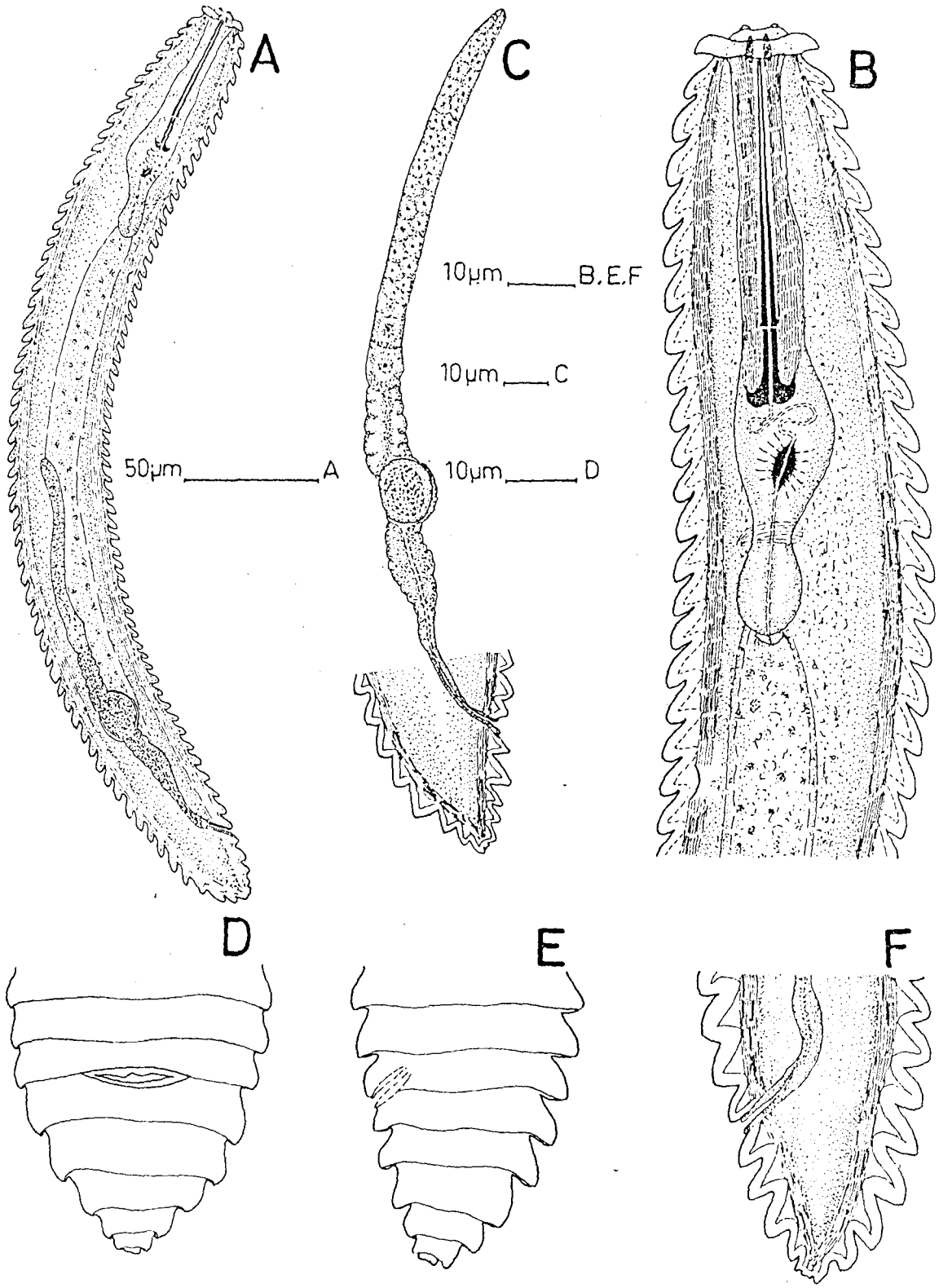

FIG. 30. Criconema retrolabiata n. sp. A. Entire female; B. Oesophageal region; C. Gonad; D. Posterior end (Ventral); E & F. Posterior end (lateral).

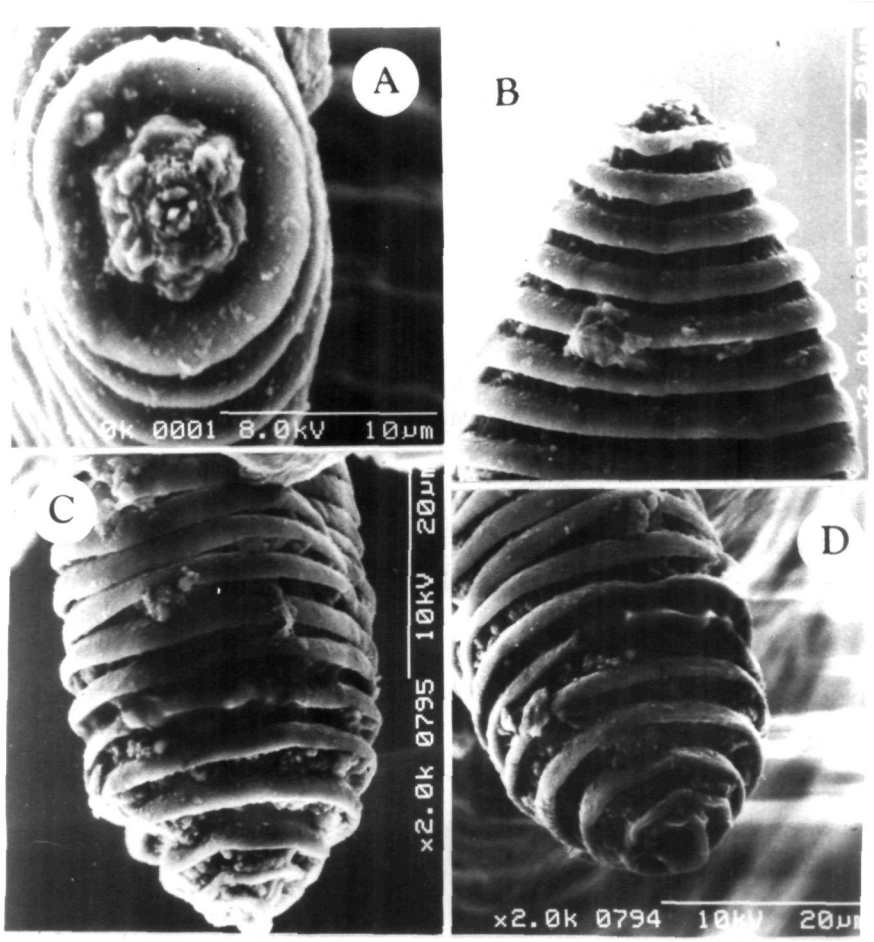

FIG. 31. Criconema retrolabiata n. sp. A. En face view; B. Female anterior end; C & D. Posterior ends.

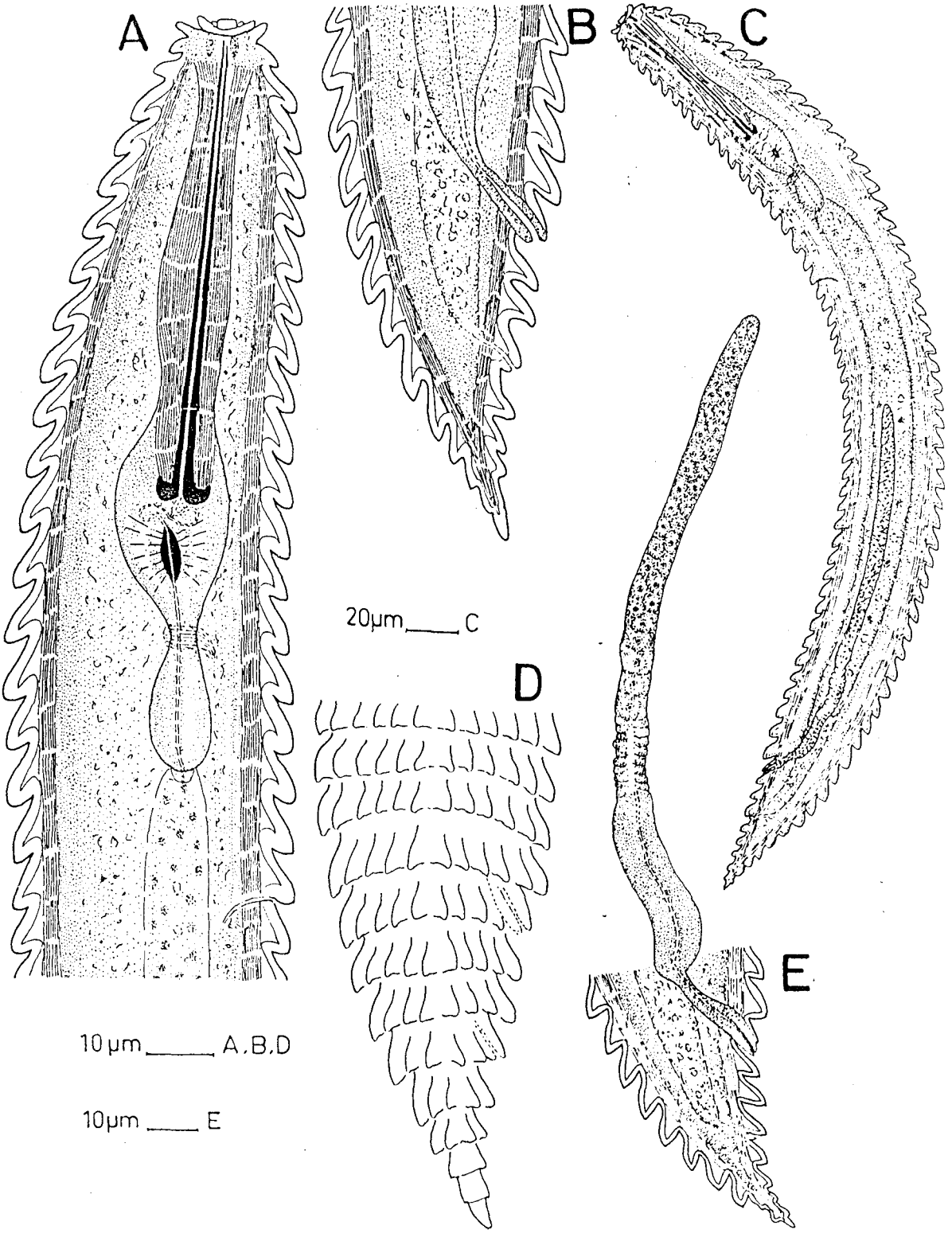

FIG. 32. Criconemella chamolii n. sp. A. Oesophageal region; B & D. Posterior ends; C. Entire female; E. Gonad.

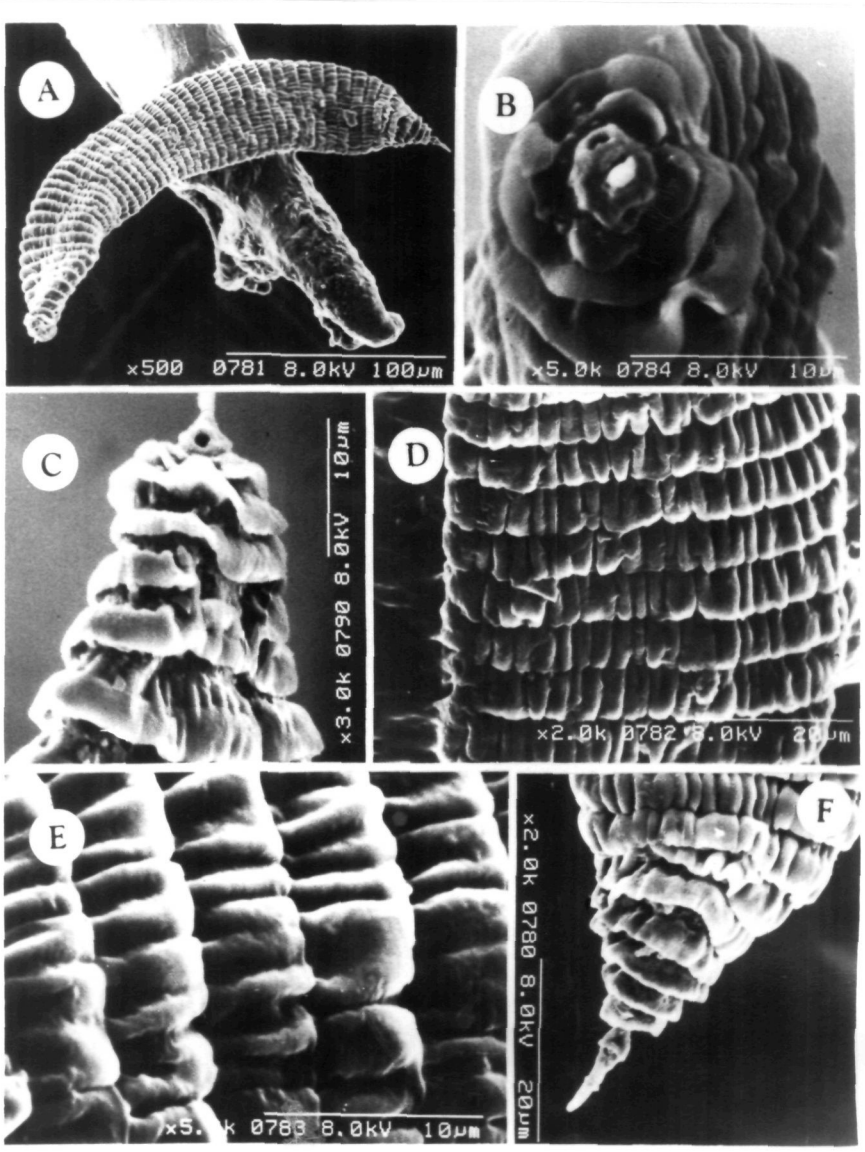

FIG. 33. Criconemella chamolii n. sp. A. Entire female; B. En face view; C. Female anterior end; D & E. Cuticle at midbody; F. Posterior end.

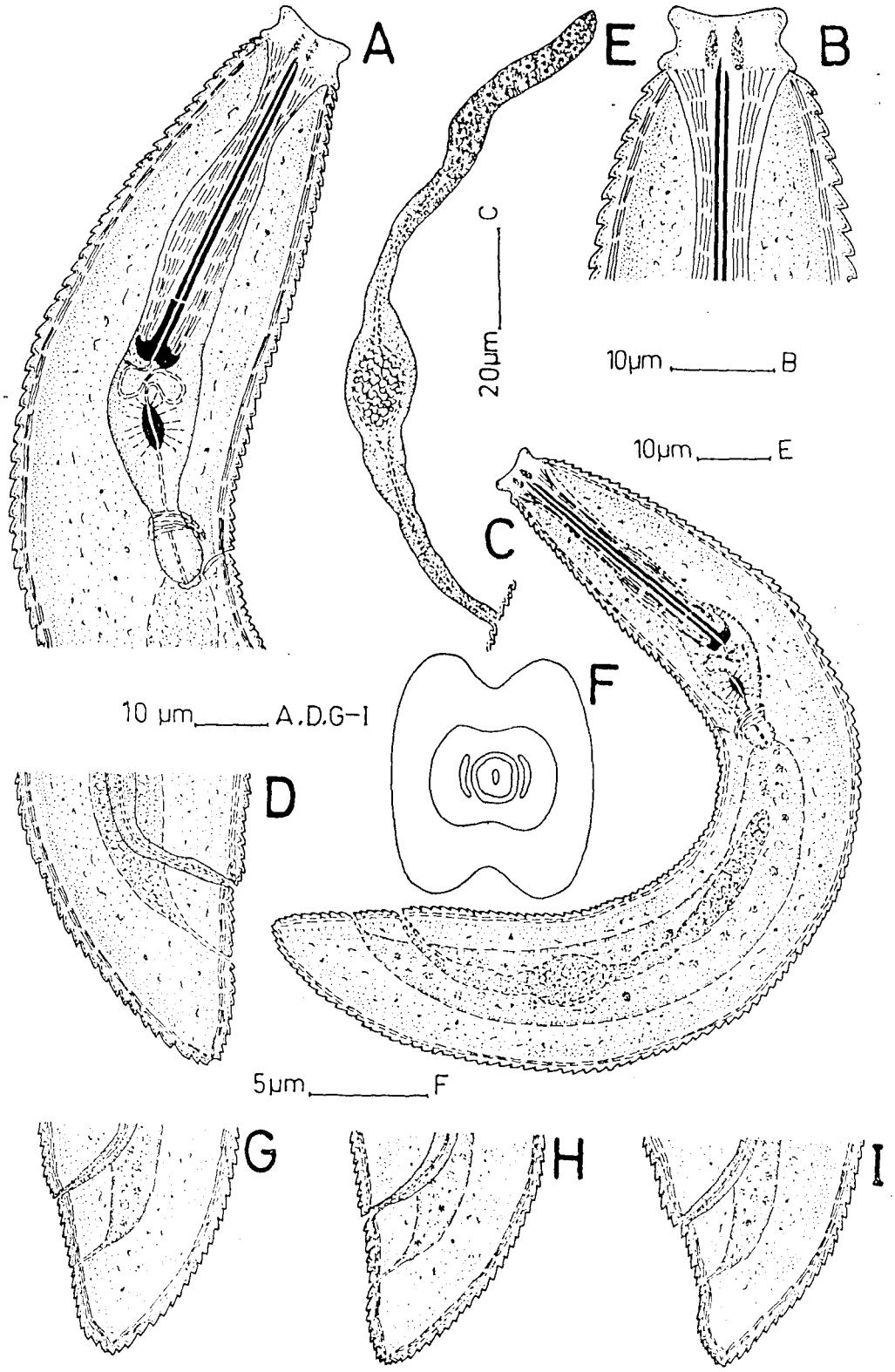

FIG. 34. Discocriconemella limitanea. A. Oesophageal region; B. Head end; C. Entire female; D, G-I. Posterior ends; E. Gonad; F. Face view.

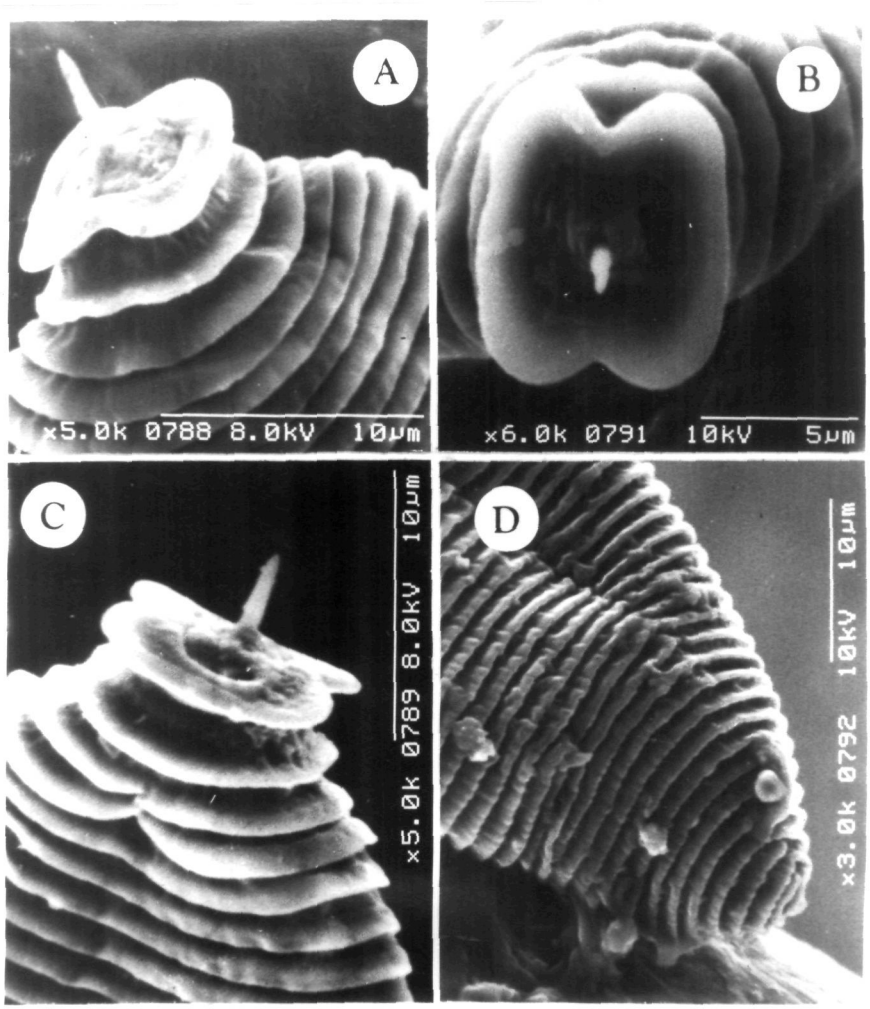

FIG. 35. Discocriconemella limitanea. A & C. Anterior ends; B. En face view; D. Posterior end.

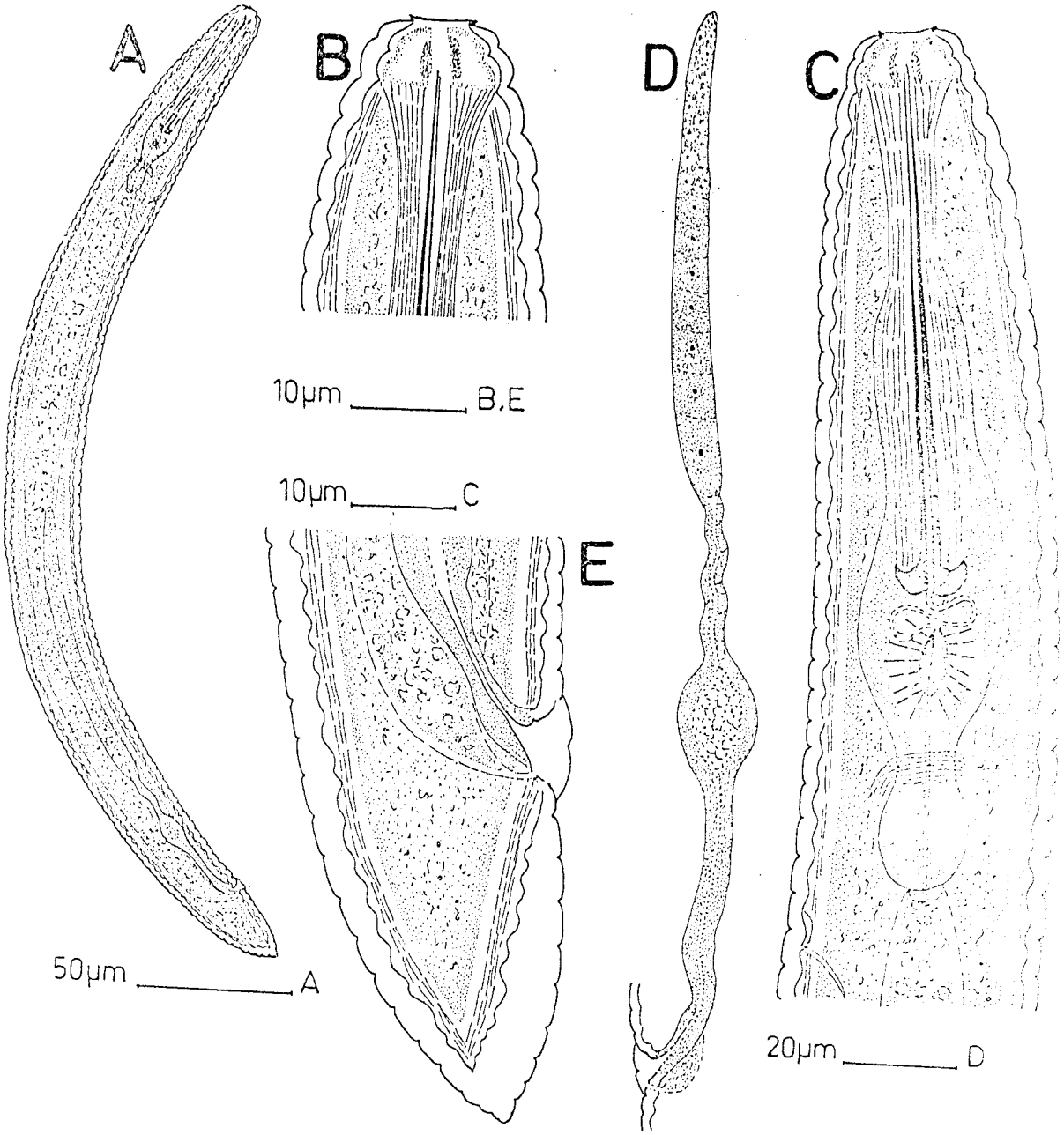

FIG. 36. Hemicriconemoides cocophilus. A. Entire female; B. Head end; C. Oesophageal region; D. Gonad; E. Posterior end.

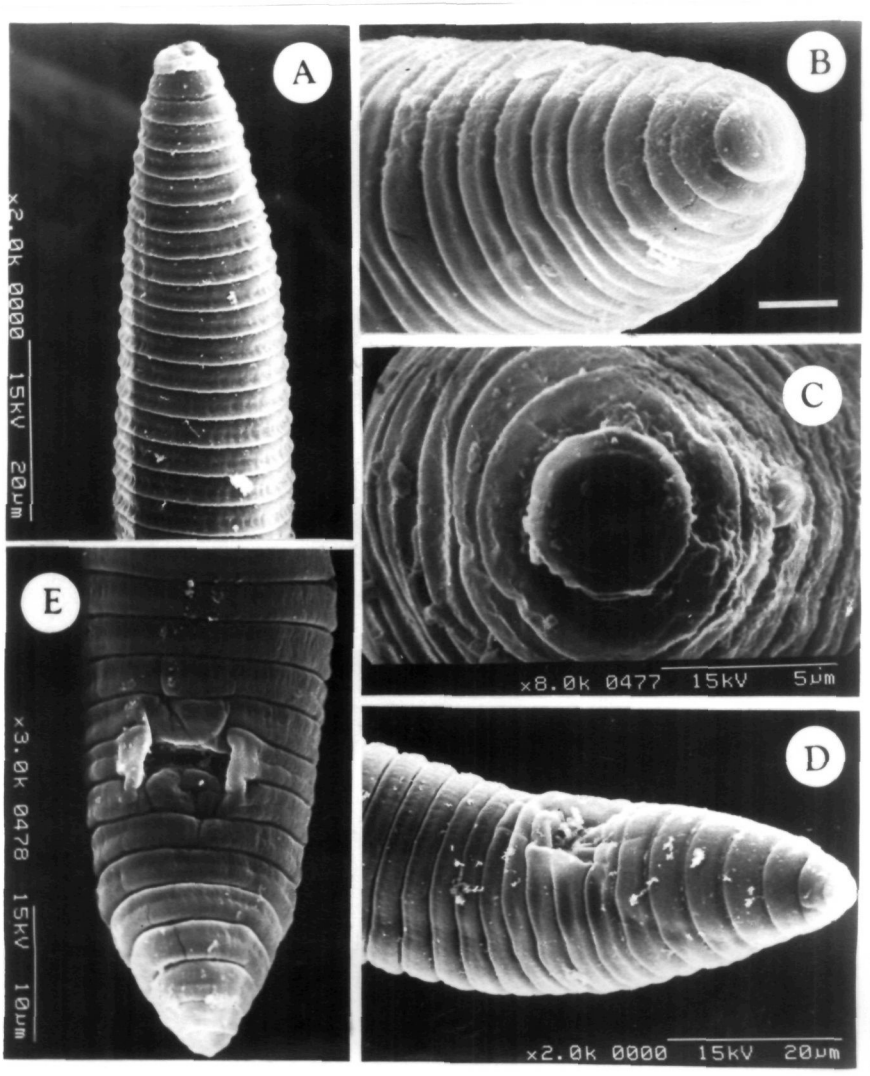

FIG. 37. Hemicriconemoides cocophilus. A & B. Anterior ends; C. En face view; D & E. Tail ends (Scale: Bar= 5 um in B).

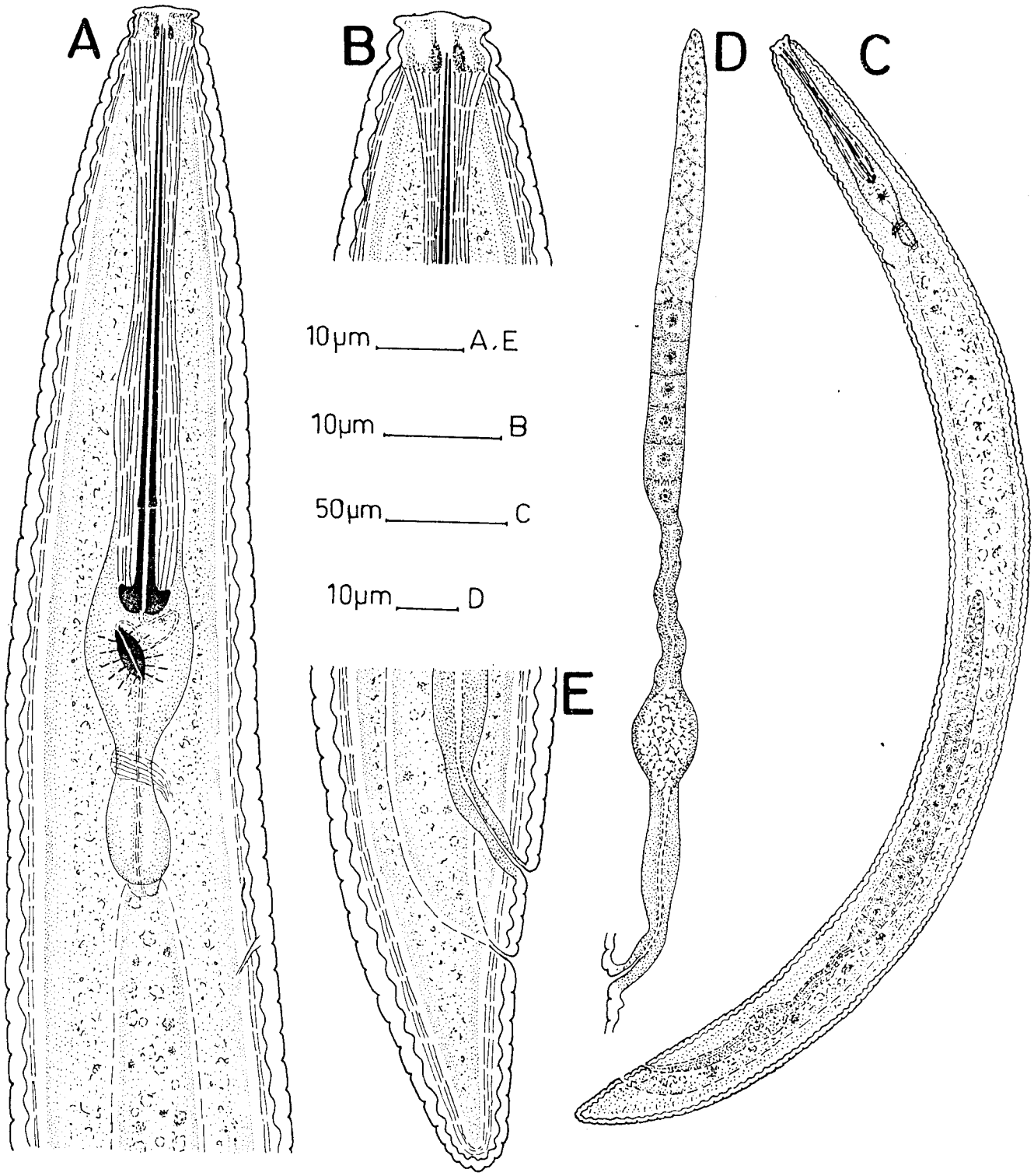

FIG. 38. Hemicriconemoides mangiferae. A. Oesophageal region; B. Head end; C. Entire female; D. Gonad; E. Posterior end.

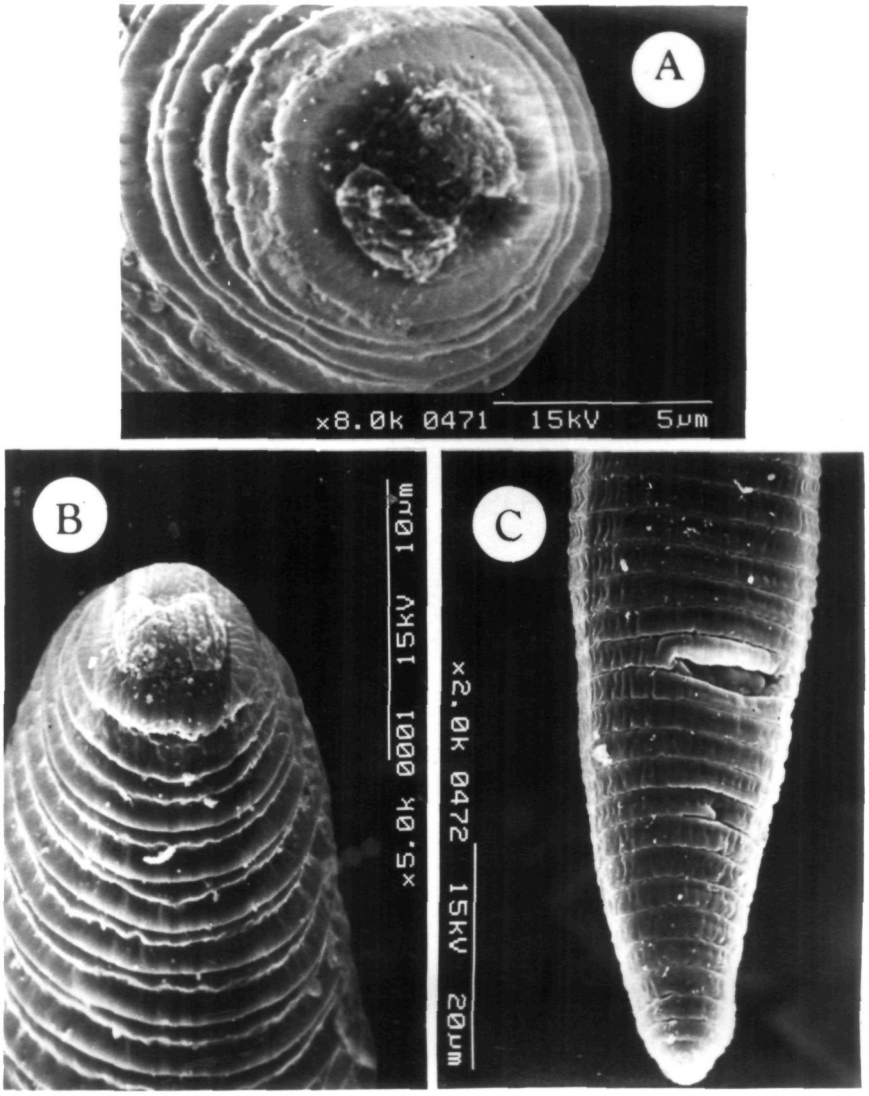

FIG. 39. Hemicriconemoides mangiferae. A. En face view; B. Anterior end; C. Tail end.

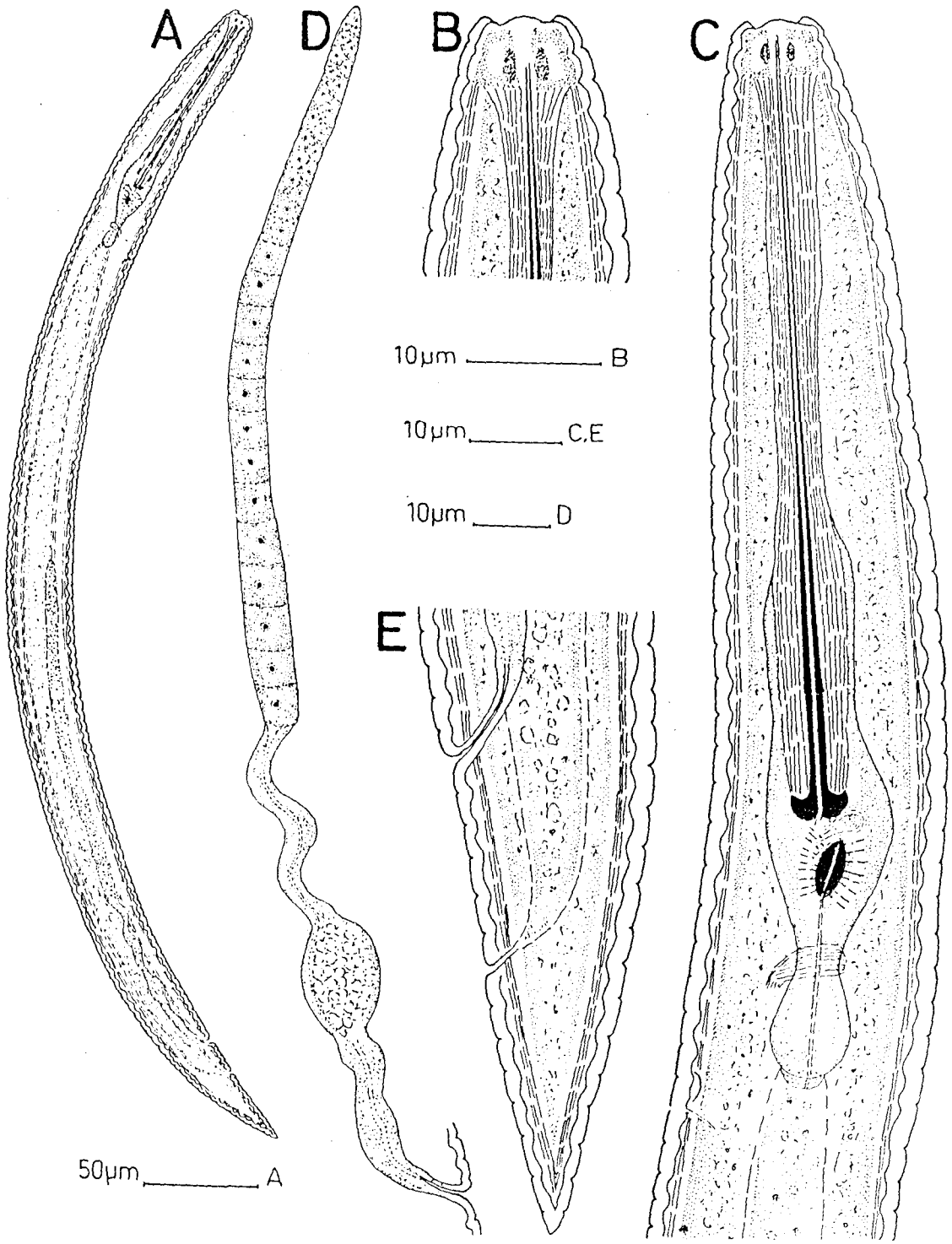

FIG. 40. Hemicriconemoides gaddi. A. Entire female; B. Head end; C. Oesophageal region; D. Gonad; E. Posterior end.

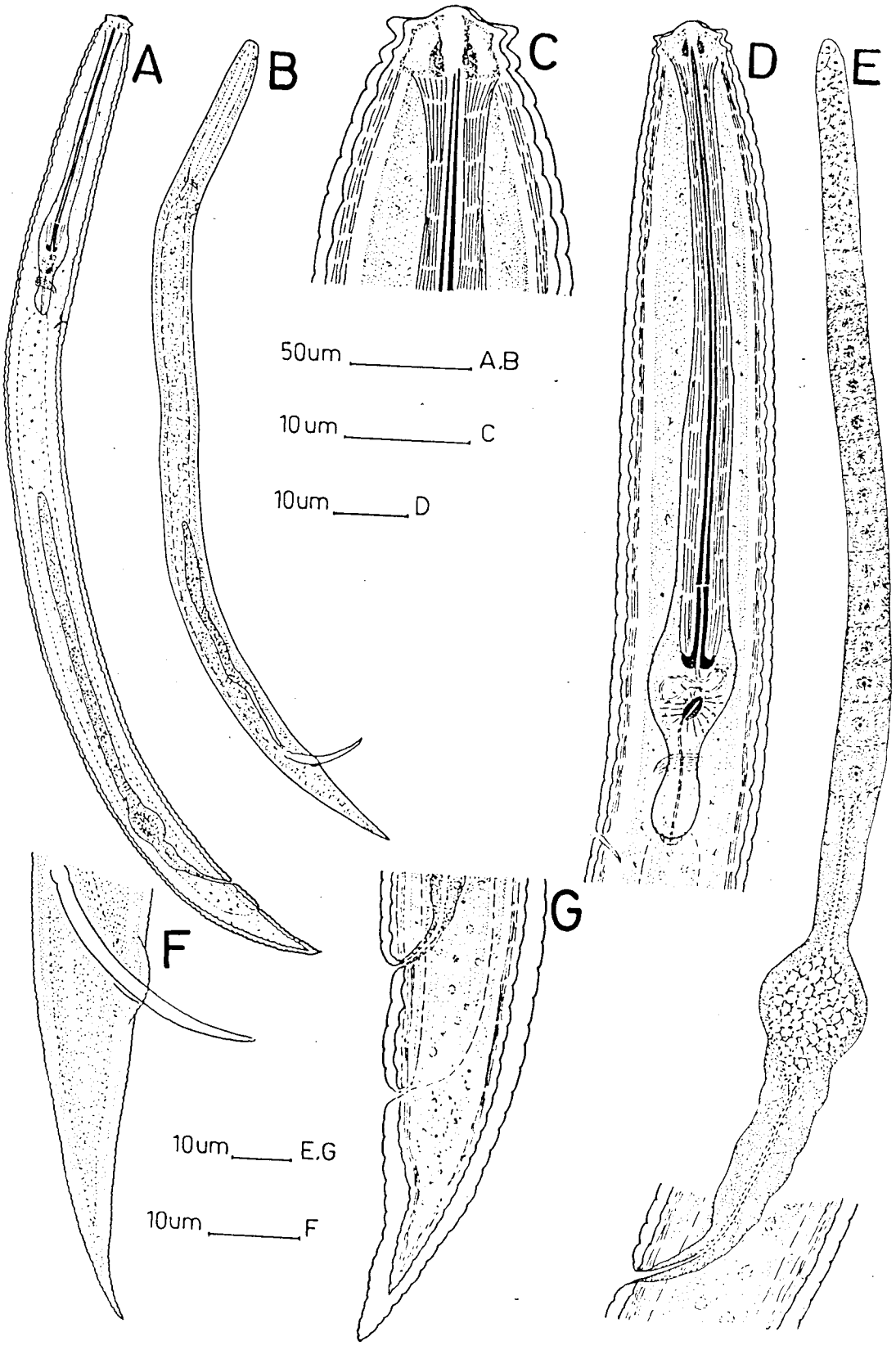

FIG. 41. Hemicriconemoides variabilis n. sp. A. Entire female; B. Entire male; C. Female head end; D. Female oesophageal region; E. Female gonad; F. Male tail end; G. Female posterior end.

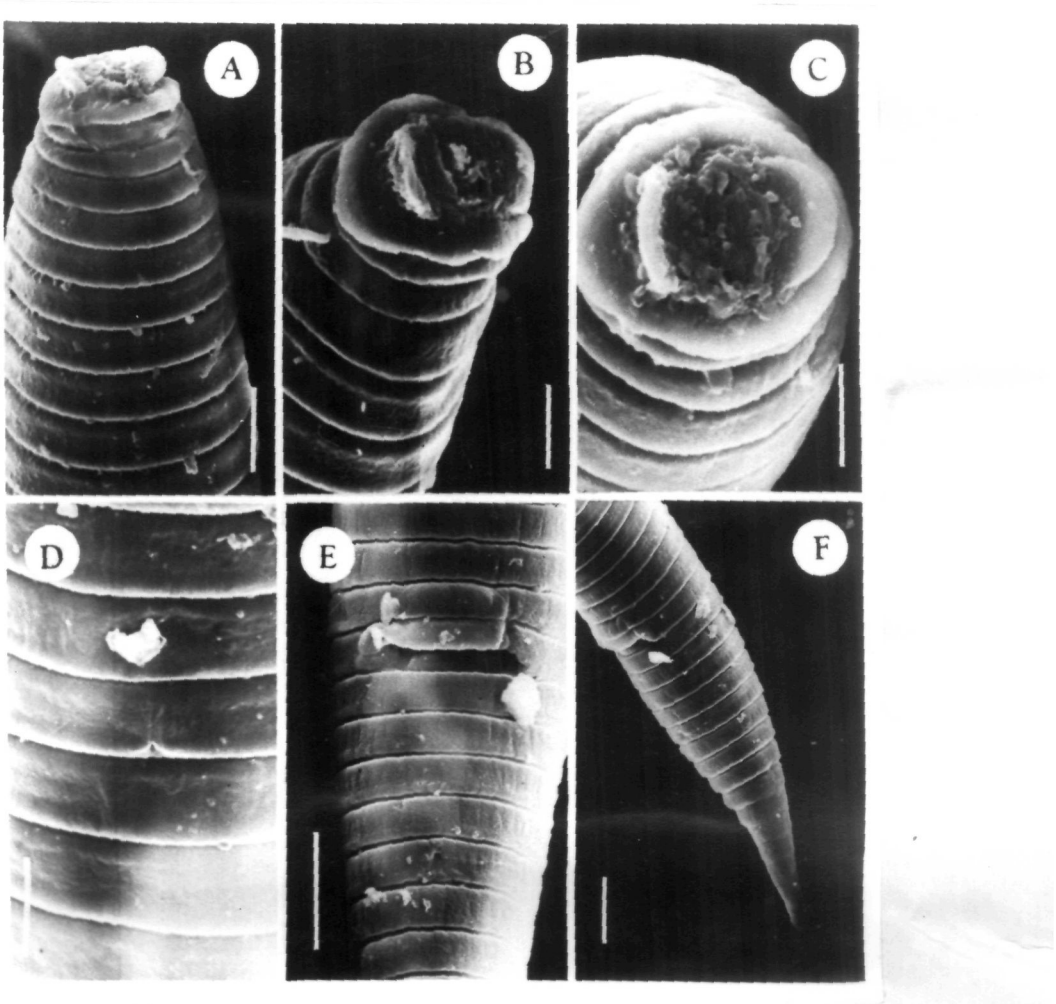

FIG. 42. Hemicriconemoides variabilis n. sp. A & B. Anterior ends; C. En face view; D. Excretory pore; E. Vulva and anal region; F. Female posterior end (Scale: Bar= 10 um in A,E,F; 3 um in B & C; 4 um in D).

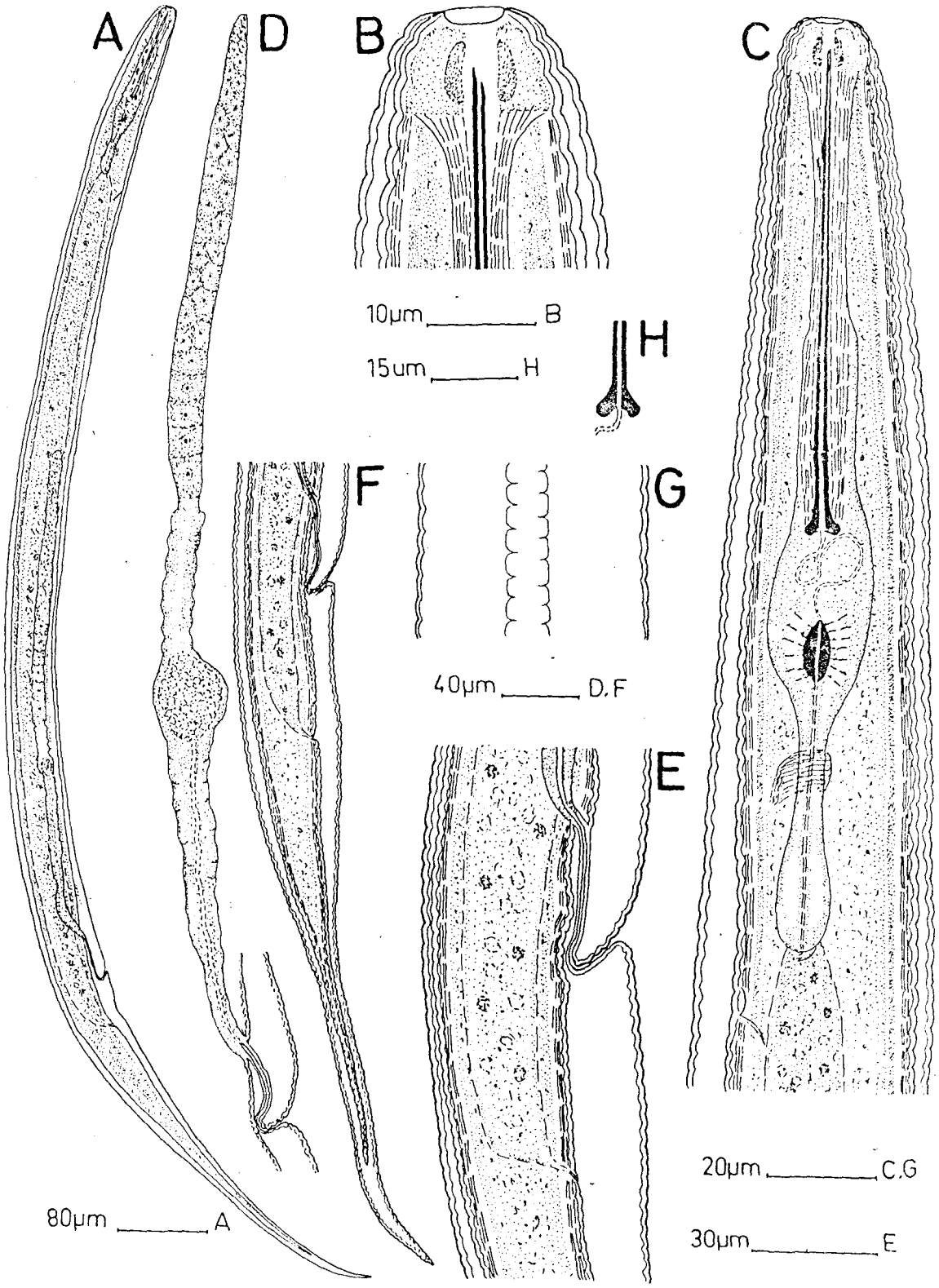

FIG. 43. Hemicycliophora meghalayaensis n. sp. A. Entire female; B. Head end; C. Oesophageal region; D. Gonad; E. Vulva and anal region; F. Posterior end; G. Lateral field; H. Stylet knobs.

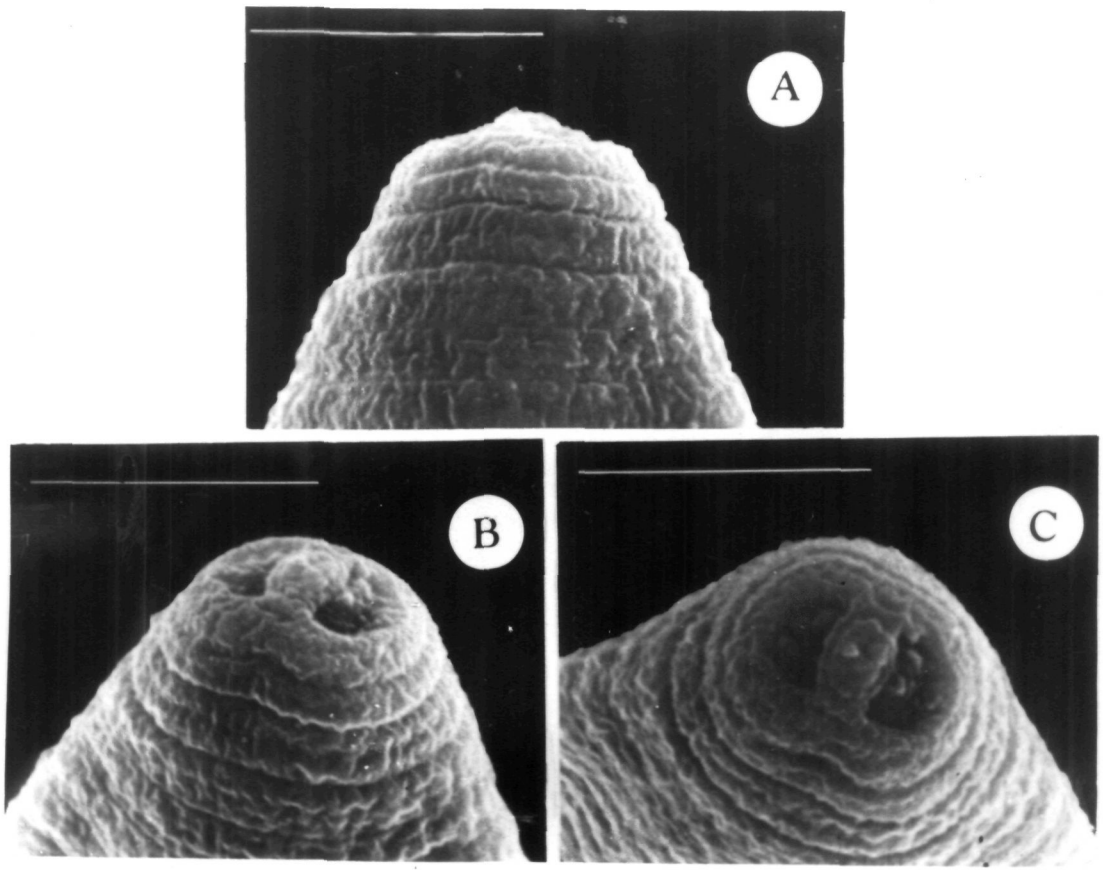

FIG. 44. Hemicycliophora meghalayaensis n. sp. A & B. Anterior ends; C. En face view (Scale: Bar= 10um in A-C).

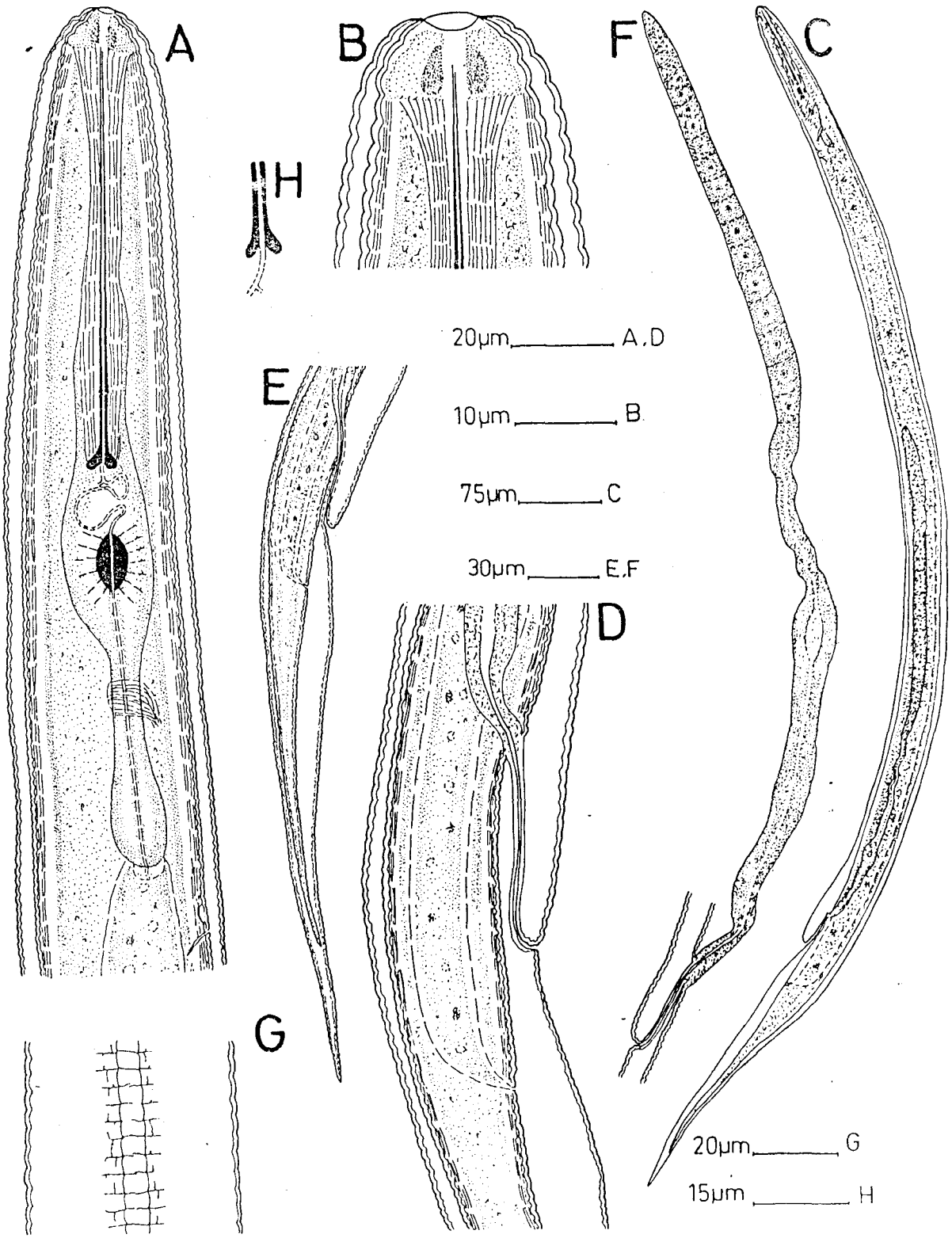

FIG. 45. Hemicycliophora attapadii n. sp. A. Oesophageal region; B. Head end; C. Entire female; D. Vulva and anal region; E. Posterior end; F. Gonad; G. Lateral field; H. Stylet knobs.

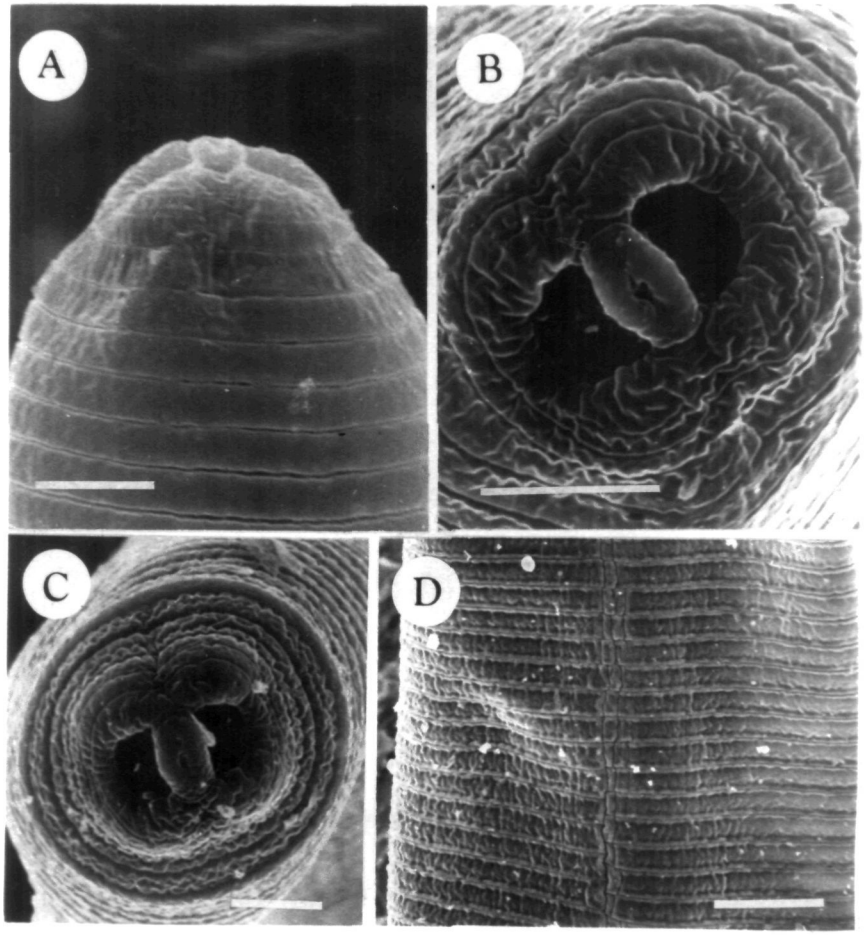

FIG. 46. Hemicycliophora attapadii n. sp. A. female anterior end; B & C. En face views; D. Lateral field (Scale: Bar= 5 um in A-C; 10 um in D).

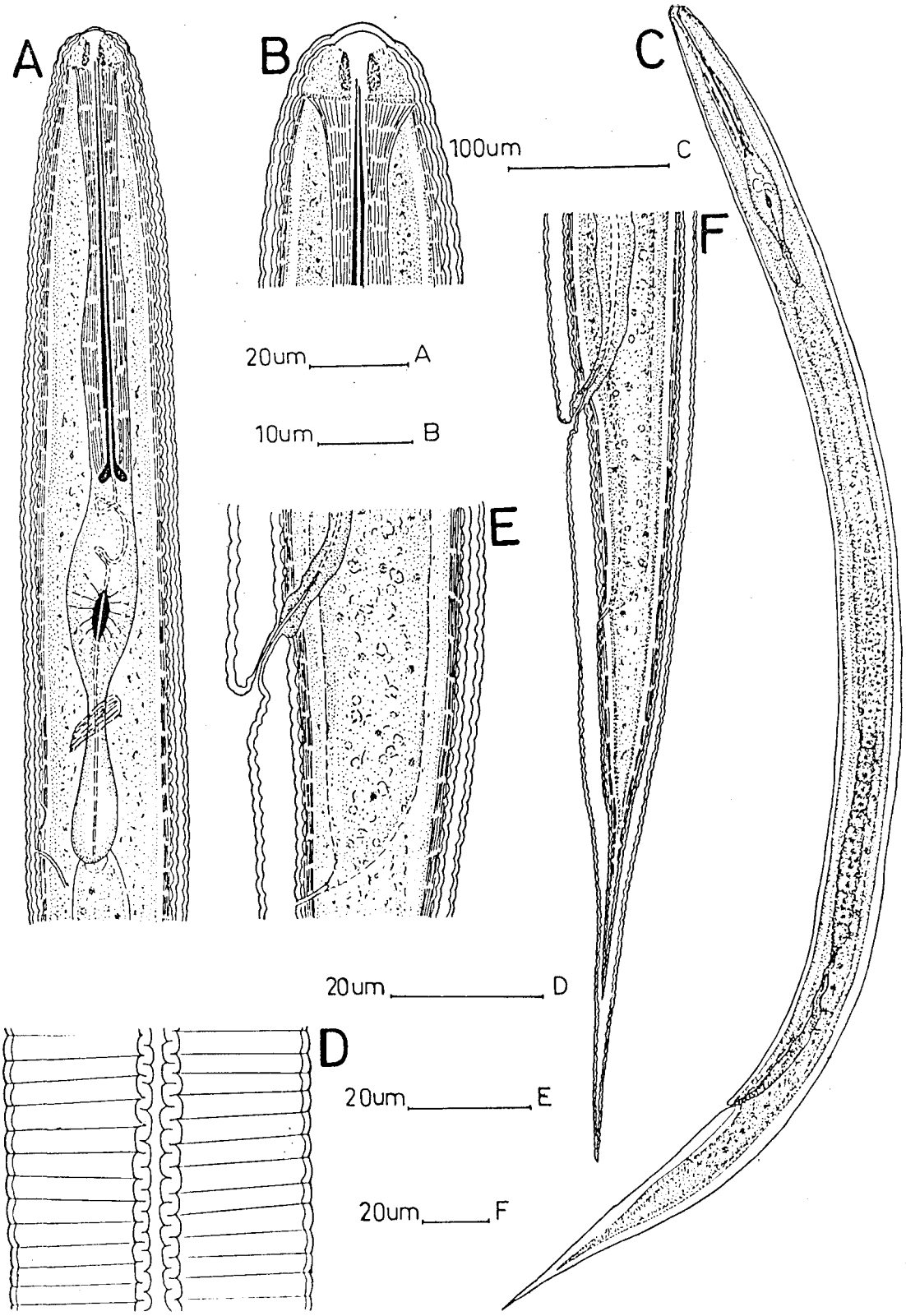

FIG. 47. Hemicycliophora postamphidia n. sp. A. Oesophageal region; B. Head end; C. Entire female; D. Lateral field; E. Vulva and anal region; F. Posterior end.

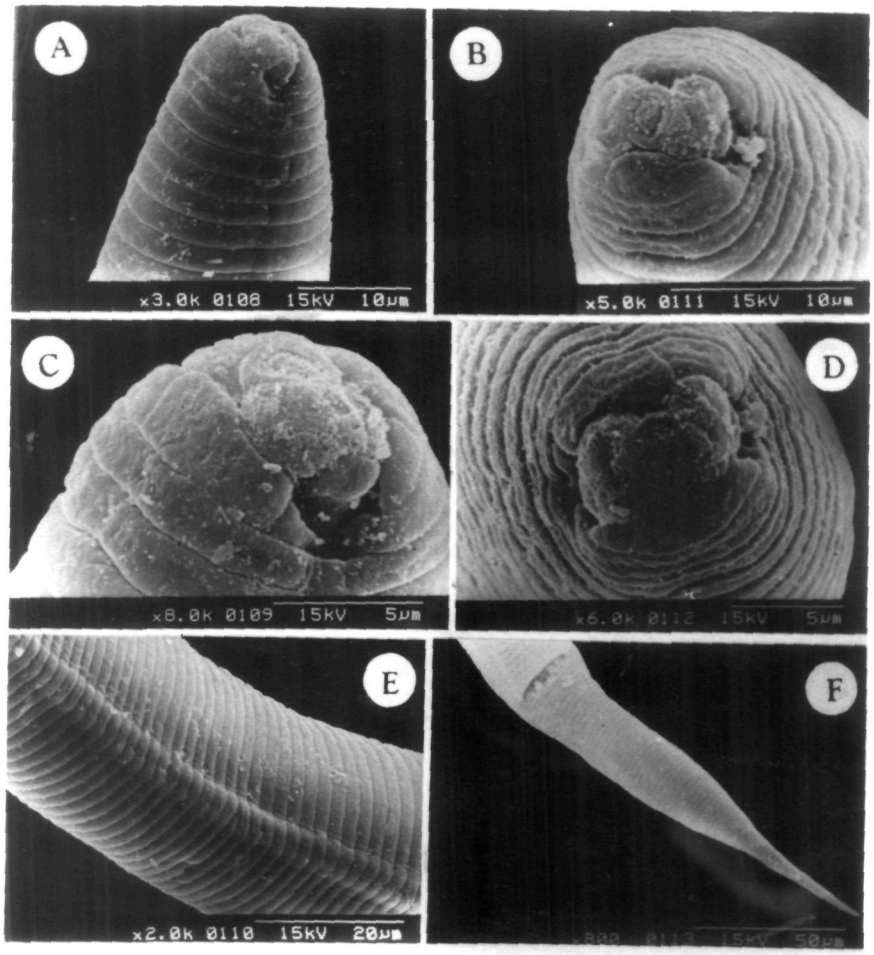

FIG. 48. Hemicycliophora postamphidia n. sp. A-C. Anterior ends; D. En face view; E. Lateral field; F. Posterior end.

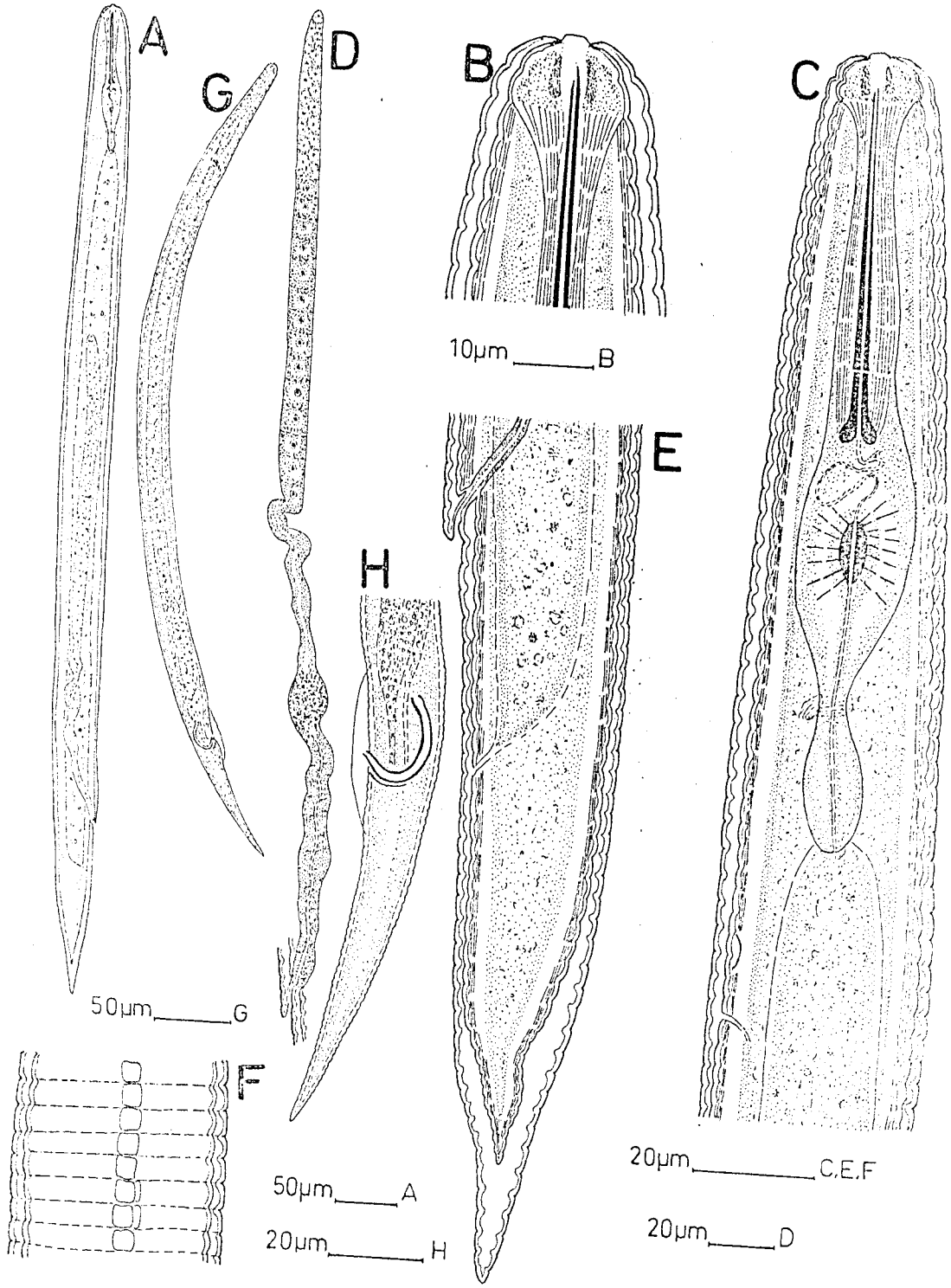

FIG. 49. Hemicycliophora dhirendri. A. Entire female; B. Head end; C. Oesopheageal region; D. Gonad; E. Female posterior end; F. Female lateral field; G. Entire male; H. Male posterior end.

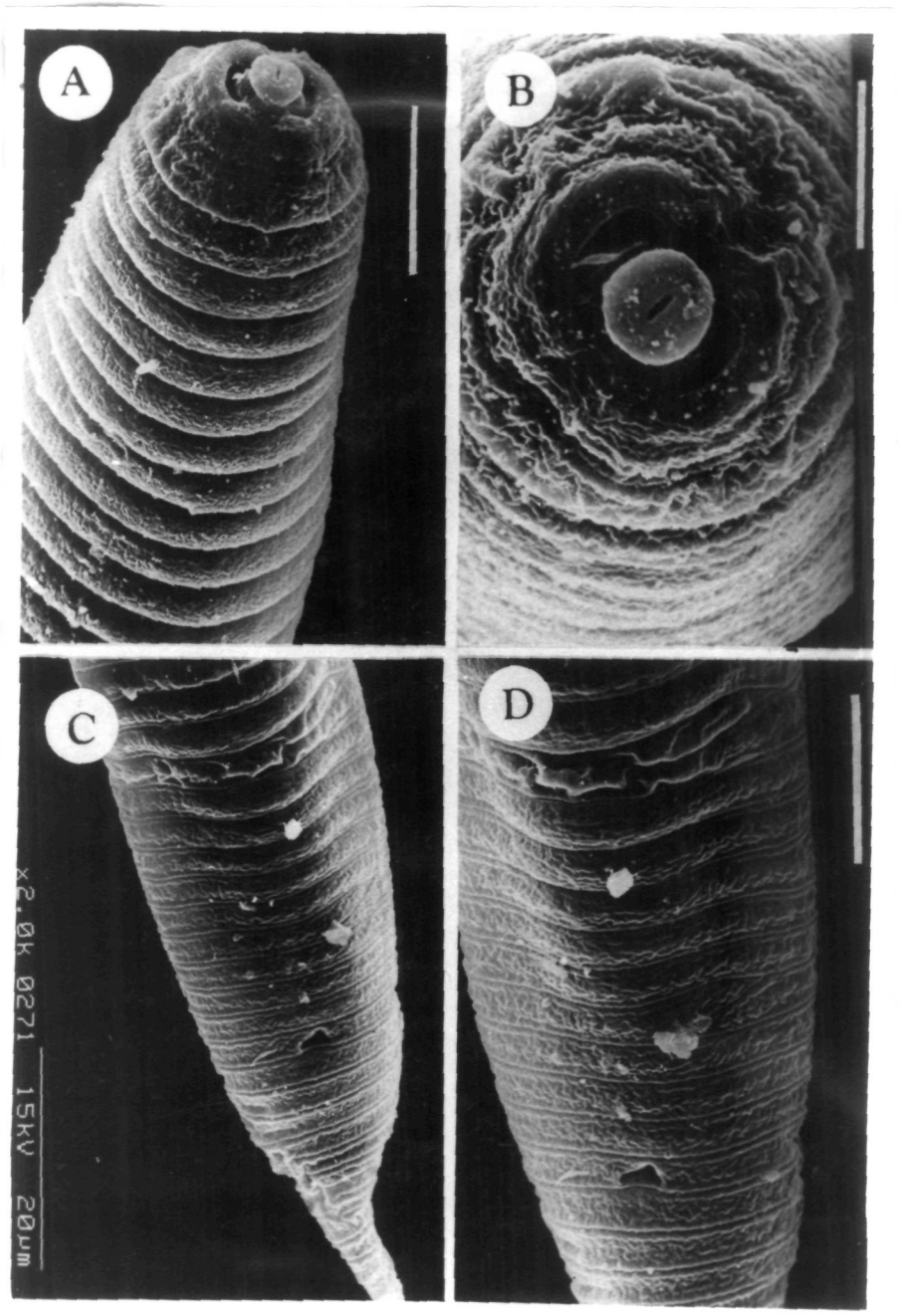

FIG. 50. Hemicycliophora dhirendri. A. Female anterior end; B. En face view; C. Female posterior end; D. Vulva-anal region (Scale: Bar= 10 um in A,D; 20 um in B,C).

APPENDIX - I & II

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Two new species of Tylenchoidea (Nemata) and observations on *Merlinius macrodens* (Allen, 1955) Siddiqi, 1970

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Summary — Two new species of Tylenchoidea are described and illustrated. *Brachydorus kazirangai* n. sp. has 1.63-1.91 mm long body, a = 63-75; b = 8.5-11.3; c = 17-21; V = 51-53; stylet = 27-30 µm; spicules = 40.5-42 µm and is characterized by a large circular cephalic region without dorsal and ventral indents, large slit-like amphidial apertures and lateral fields areolated in anterior end only. *Trichotylenchus astriatoides* n. sp. has L = 0.56-0.68 mm; a = 31-35; b = 4.7-5.4; c = 11-12; V = 54-56; stylet = 22.5-24 µm; spicules = 21 µm and is characterized by a striated lip region, irregularly areolated lateral fields along entire body length and a dorso-laterally overlapping oesophageal lobe. Additional morphological data is provided on *Merlinius macrodens* (Allen, 1955) Siddiqi, 1970.

Résumé — ***Deux nouvelles espèces de Tylenchoidea (Nemata) et observations sur* Merlinius macrodens *(Allen, 1955) Siddiqi, 1970*** — Deux nouvelles espèces de Tylenchoidea sont décrites et figurées. *Brachydorus kazirangai* n. sp. a un corps long de 1,63-1,91 mm; a = 63-75; b = 8,5-11,3; c = 17-21; V = 51-53; stylet = 27-30 µm; spicules = 40,5-42 µm; il est caractérisé par une région céphalique globuleuse, large, sans indentations dorso-ventrales, de grandes fentes amphidiennes et un champ latéral aréolé dans sa portion antérieure seulement. *Trichotylenchus astriatoides* n. sp. a un corps long de 0,56-0,68 mm; a = 31-35; b = 4,7-5,4; c = 11-12; V = 54-56; stylet = 22,5-24 µm; spicules = 21 µm; il est caractérisé par une région labiale striée, un champ latéral irrégulièrement aréolé sur toute la longueur du corps et un lobe œsophagien recouvrant dorso-latéralement l'intestin. Des données morphologiques supplémentaires sont fournies pour *Merlinius macrodens* (Allen, 1955) Siddiqi, 1970.

Key-words : *Merlinius, Brachydorus, Trichotylenchus.*

Soil samples collected from Assam and Andhra Pradesh, India, yielded one species each of the genus *Brachydorus* de Guiran & Germani, 1968 and *Trichotylenchus* Whitehead, 1960. The genus *Brachydorus* was proposed by de Guiran and Germani (1968) from Madagascar with *B. tenuis* as its type species. Koshy *et al.* (1981) added a second species, *B. swarupi* from India. Luc and Fortuner (1987) considered it a *genus dubium* but a SEM study by Raski and Luc (1988) confirmed its validity. The present specimens represent the third species of the genus and is named *B. kazirangai* n. sp. The specimens of *Trichotylenchus* upon detailed study were also found to represent a new species, *T. astriatoides* n. sp. Specimens of *Merlinius macrodens* (Allen, 1955) Siddiqi, 1970 collected at an altitude of 4500 m represents the first report of this species from Himachal Pradesh (India).

The specimens for light microscopy were killed and fixed in hot 4 % formalin, dehydrated in a desiccator by the slow method and mounted in anhydrous glycerine. Measurements were made with an ocular micrometer. For scanning electron microscopy, formalin fixed specimens were washed in buffer, post-fixed in osmium tetroxide, dehydrated in an alcohol series and critical point dried in CO_2. After coating with 30 nm gold, the specimens were observed in a Hitachi S 2300 scanning electron microscope at 15 kV.

Brachydorus kazirangai n. sp.
(Figs 1 & 2)

DIMENSIONS

See Table 1.

DESCRIPTION

Female : Body slender, slightly to strongly ventrally curved upon fixation, tapering gradually anterior to base of oesophagus, posteriorly terminating as a long slender tail. Cuticle finely striated, each stria about 1.0-1.5 µm apart at midbody. Lateral fields with three ridges (four lines) occupying 25-30 % body width at midbody, areolated in anterior third of body only. The two outer ridges broader (2 µm) than the middle one (1.2 µm); outer ridges crenate in the posterior third of body and areolated only in the region where they merge with the tail striae. Lip region dome-shaped, distinctly set off by a constriction, 8-10 µm wide and 6-7 µm high with seven or eight fine annules. Labial region circular in face view, without dorsal and ventral indents. Lips amalgamated, oral aperture obscured by debris but apparently a small dorso-ventral slit. Labial disc circular, about 3 µm in diam. Amphidial apertures prominent, slit-like, about 2 µm wide, dorso-ventrally oriented along labial disc contour. Cephalic framework strongly sclerotized. Stylet slender, conus attenuated, about half of total stylet

Table 1. Dimensions of *Brachydorus* species (all measurements in µm, except L).

	B. kazinangai n. sp.				*B. sicanapi*		*B. tenuis*	
	Females (paratype)	Males (paratype)	Juveniles	Holotype (female)	Females	Males	Females	Males
n	3	2	10	1	13	13	23	23
L (mm)	1.63-1.91 (1.74 ± 0.17)	1.59-1.61	1.22-1.43 (1.38 ± 0.05)	1.83	1.87-2.34 (2.13)	1.52-1.99 (1.78)	1.03-1.32 1.18)	0.86-1.10 (0.99)
a	63-75 (69 ± 6.9)	63-67	59-62 (61 ± 1.2)	72	53-67 (61)	50-64 (58)	38-46 (42)	37-47 (41.2)
b	8.5-11.3 (8.8 ± 1.4)	7.9-8.2	7.3-8.5 (8.2 ± 0.5)	11.3	7.8-9.6 (8.5)	6.5-8.0 (7.3	6.5-7.6 (7.0)	5.2-7.7 (6.1)
c	17-21 (18 ± 2.2)	82-89	13-17 (15 ± 1.4)	21	10-16 (13)	48-70 (56)	8.6-11.5 (9.7)	33-48 (42.3)
c′	4.2-4.9 (4.8 ± 0.1)	0.92-1.0	3.6-4.0 (3.8 ± 0.16)	4.21	–	–	–	–
V	51-53 (52 ± 1.1)	–	–	51	48-53 (50)	–	48-55	–
Stylet	27-30 (28 ± 1.7)	27	24-28 (27 ± 1.4)	27	28-32 (30)	26-35 (30)	20-23 21.5)	19-23 (21)
Conus	12.5-15.5 (14 ± 1.5)	13.5	12-14 (13 ± 1.0)	13.5	13-17 (15)	13-19 (15)	10-13.5	–
O	16.6-20 18.2 ± 1.7)	18.7	17-22 (19.2 ± 2.2)	18.6	–	–	–	–
Ant. end to nerve ring	144-152 (148 ± 4.0)	140-149	130-142 (136 ± 3.6)	150	–	–	–	–
Ant. end to excret. pore	165-174 (169.6 ± 4.5)	164-171	150-162 (155 ± 2.8)	170	–	–	124-152	–
Tail	93-103.5 (97 ± 5.6)	18-19.5	82.5-95 (89 ± 4.3)	94.5	–	–	104-133	–
Spicules	–	40.5-42	–	–	–	50-57 (54)	–	22-39
Gubernaculum	–	13.5	–	–	–	20-26 (21)	–	9-12
Bursa	–	57-63	–	–	–	–	–	–

length. Knobs rounded, slightly posteriorly directed, 3.5-4.5 µm wide across. Orifice of dorsal oesophageal gland 4-5 µm behind spear base. Oesophagus 160-203 µm long. Procorpus slender, 65-90 µm long, gradually enlarging to a muscular oval metacorpus. Metacorpus 18-22 µm long and 15 µm wide with 6-7 µm long sclerotized valve plates. Isthmus small, 17-33 µm long. Basal bulb ovate, 27-34 µm long. Excretory pore near the base of isthmus, 165-174 µm from anterior end. Hemizonid anterior to excretory pore. Cardia short, conoid, 3-4 µm long. Intestine slightly overlapping the basal bulb laterally. Gonads amphidelphic, outstretched, oocytes arranged in a single row. Vulva a transverse slit, 10-11 µm wide, vagina strongly sclerotized, 15-22 µm wide. Uterus with proximal glandular and distal muscular part; spermatheca spheroid, 14-18 µm in diam. Tail elongate conoid, 88-104 µm long, tapering gradually posterior to anus, terminus pointed. Phasmids minute, pore-like, about 10 µm posterior to anus.

Male : Similar to female except for a slightly smaller body and sexual dimorphism in the tail shape. Cloacal aperture elliptical with posterior tip provided with a saddle-like flap. Arising from below the flap are two outwardly directed additional flaps. Spicules arcuate, well developed, capitulum elongated, tips slightly bifid. Gubernaculum hook-shaped, distal end directed dorsally. Tail 18-19 µm long narrowing suddenly behind cloacal opening, terminus pointed. Bursa with large lobes projecting beyond tail tip and bearing fine annulations. Anterior margin of bursa smooth, posterior margin irregular.

Juveniles : Similar to females. Labial disc prominent, circular, less than 3 µm in diam. Amphidial slits slightly

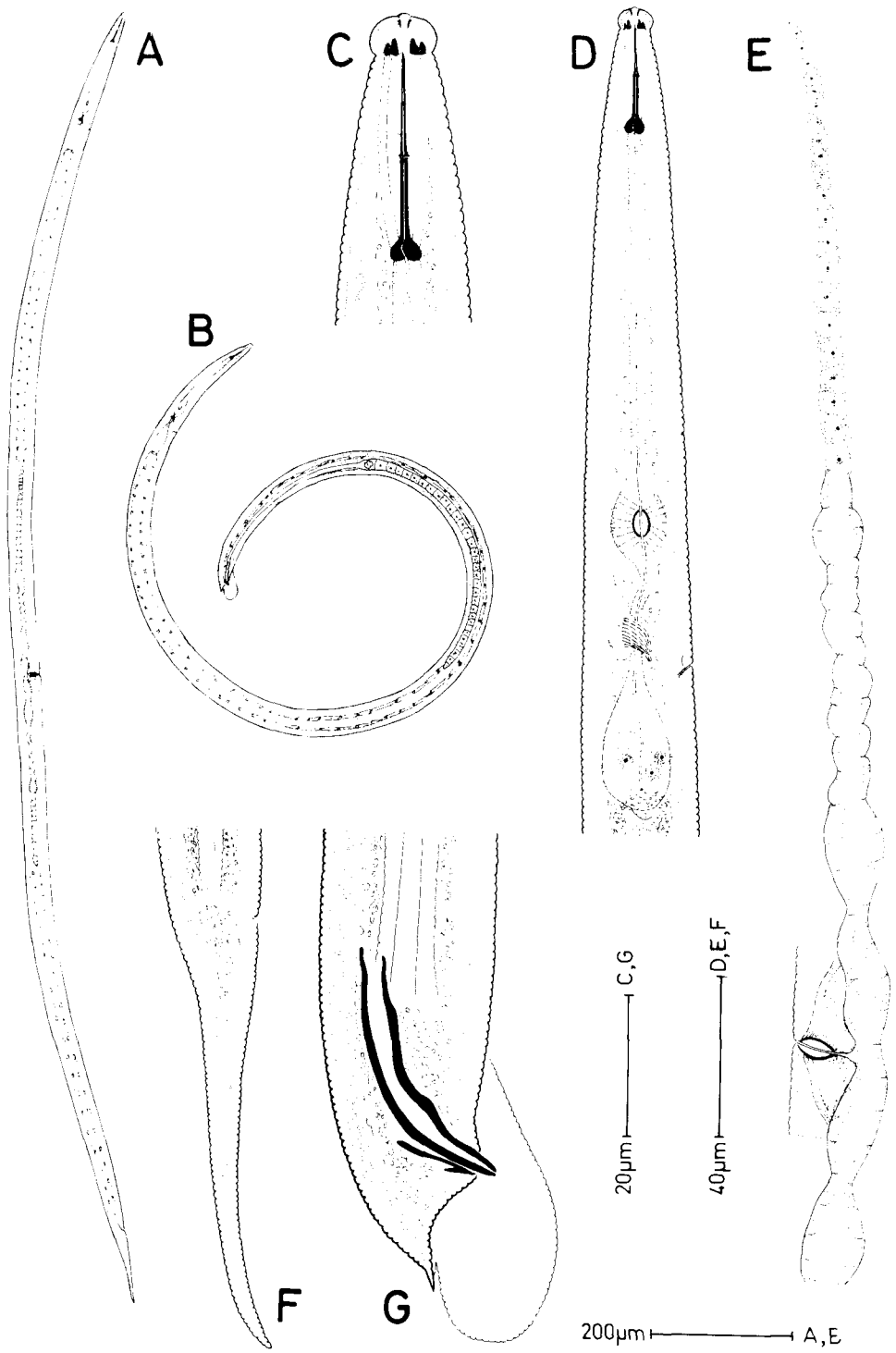

Fig. 1. *Brachydorus kazirangai* n. sp. — A : Entire female; B : Entire male; C : Anterior region; D : Oesophageal region; E : Female gonad (anterior); F : Female tail; G : Male tail.

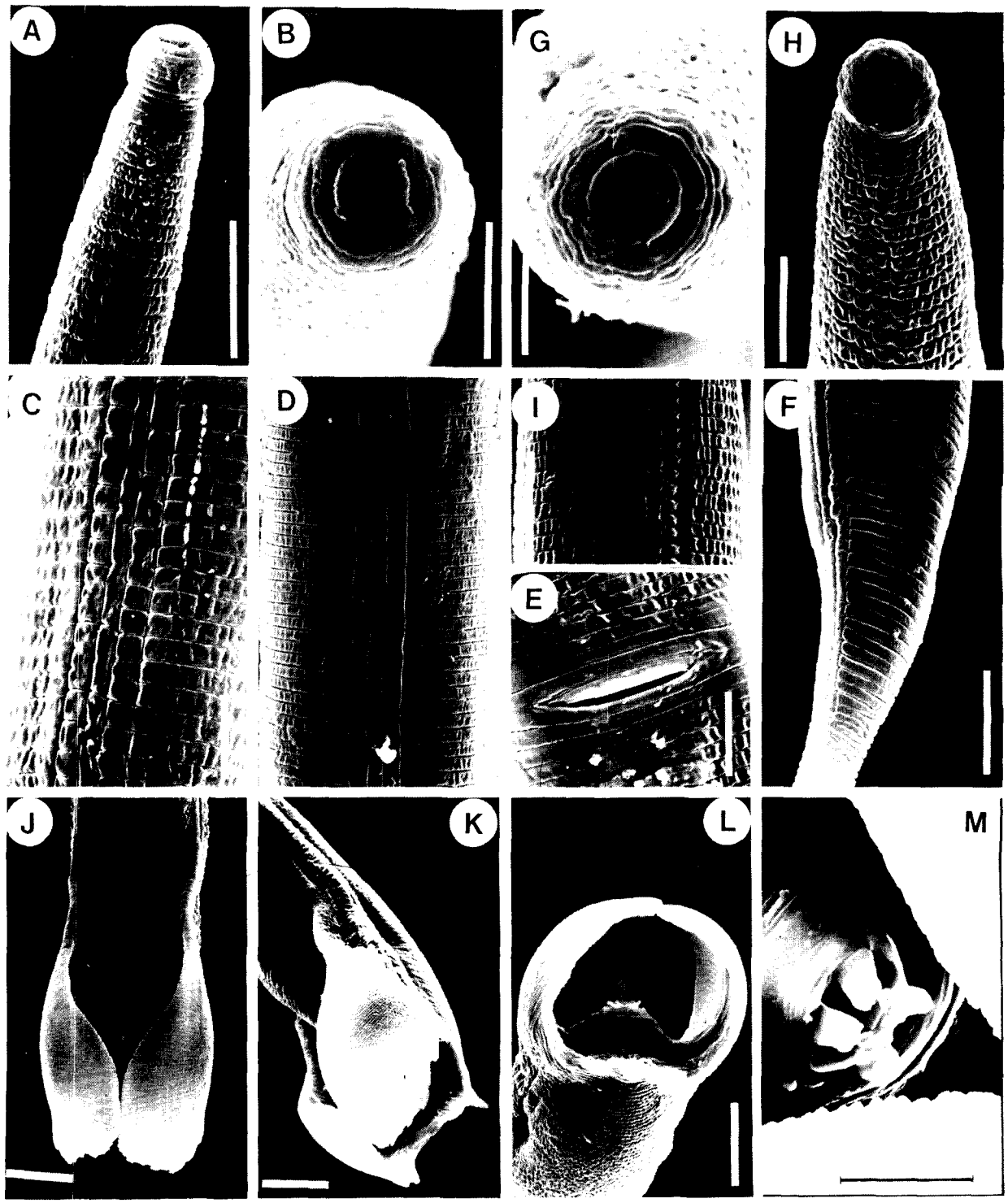

Fig. 2. *Brachydorus kazirangai* n. sp. — A-F : Female. A : Anterior end; B : Face view; C : Lateral field (oesophageal region); D : Lateral field (midbody); E : Vulva; F : Anal region. — G-I : Juveniles. G : Face view; H : Anterior end; I : Lateral field (oesophageal region). — J-M : Male posterior region. J : Ventral view; K : Latero-ventral view; L : Posterior end-on view; M : Cloacal region. *(Bars equivalent : A, D, F, I-L = 10 µm; B, C, E, H, M = 5 µm; G = 3 µm.)*

curved along contour of labial disc, tips expanded. Lateral fields with three ridges, completely areolated in anterior third of body and irregularly areolated on tail.

TYPE MATERIAL

Holotype : Female on slide *Brachydorus kazirangai* n. sp./1 deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Paratypes : Females, males and juveniles on slides *Brachydorus kazirangai* n. sp./2-8, deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh. One paratype female and two juveniles at Muséum national d'Histoire naturelle, Laboratoire des Vers, Paris, France.

TYPE HABITAT AND LOCALITY

Soil around the roots of wild grasses (unidentified) from Kaziranga National Park, Assam, India; collected in February, 1990.

DIAGNOSIS AND RELATIONSHIP

B. kazirangai n. sp. is the third species of the genus and is characterized by having a large body size, cephalic region circular in face view without dorsal and ventral indents, large dorso-ventral slit-like amphidial apertures and lateral fields areolated in the anterior end only.

Because of its large body size and a long stylet *B. kaziragai* n. sp. comes close to *B. swarupi* Koshy, Raski & Sosamma, 1981 but differs from it in having a differently shaped lip region, amphidial apertures and gubernaculum, smaller spicules and gubernaculum and higher c value (lip region rectangular in face view with slight dorsal and ventral indents; amphidial slits oblique beginning dorsally and then angling out ventrally and laterally from labial disc; gubernaculum trough-shaped in *B. swarupi*). From *B. tenuis* de Guiran & Germani, 1968 it differs in having a long and slender body, dome-shaped lip region, longer stylet with posteriorly directed basal knobs, higher b and c values and differently shaped gubernaculum (lip region simple rounded, basal knobs subspherical and gubernaculum trough-shaped in *B. tenuis*).

Trichotylenchus astriatoides n. sp.
(Figs 3 F-J; 4 H-M)

DIMENSIONS

See Table 2.

DESCRIPTION

Female : Body slightly ventrally curved upon fixation, somewhat narrow at head and tail ends. Cuticle finely striated, each stria less than 1.0 µm wide at midbody. Lateral fields consist of two thick bands occupying about 20 % of body width at midbody, each band about 1.0-1.5 µm wide. Lateral fields irregularly areolated along entire length; areolations very fine visible only in SEM. Lip region slightly narrower than adjoining body, dorso-ventrally compressed, 6-7 µm wide, 3-4 µm high, striated. Each stria less than 0.5 µm apart. Labial sclerotization weak, face view rectangular. Amphidial apertures small, dorso-ventral slits. Stylet slender, delicate, conus attenuated, about 45 % of total stylet length. Knobs rounded, slightly posteriorly directed, 3-4 µm wide across. Orifice of dorsal oesophageal gland 1.5-3.0 µm behind spear base. Oesophagus 118-130 µm long. Procorpus slender, 28-30 µm long. Metacorpus 13.5-15.0 µm long with 3-4 µm long valve plates. Isthmus slender, 25-27 µm long. Oesophageal glands overlapping intestine dorso-laterally. Oesophago-intestinal junction in posterior one-third to one-fourth of basal lobe. Excretory pore at 94-102 µm from anterior end. Hemizonid about 2 µm anterior to excretory pore. Gonads amphidelphic, outstretched, oocytes arranged in a single row. Vulval opening a transverse slit, 3-4 µm wide. Vagina muscular, 3-4 µm wide. Spermatheca spherical 9-12 µm in diam. Uterus with proximal glandular and distal muscular region. Tail 47-55 µm long, gradually tapering to a bluntly rounded striated terminus. Phasmids indistinct. Post-anal sac 13-16 µm long.

Male : Similar to female. Spicules simple, arcuate. Gubernaculum hook-shaped, proximal end directed posteriorly. Tail 34-40 µm long, narrowing suddenly behind the cloacal opening, terminus pointed. Bursa simple, finely annulated.

TYPE HABITAT AND LOCALITY

Soil around roots of mango (*Mangifera indica*) from Srisailam, Kurnool, Andhra Pradesh, India.

TYPE MATERIAL

Holotype : Female and a paratype male on slide *Trichotylenchus astriatoides* n. sp./1; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh.

Paratypes : Females and males on slides *Trichotylenchus astriatoides* n. sp./2 and 3; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, Aligarh. One paratype female and a paratype male at Muséum national d'Histoire naturelle, Laboratoire des Vers, Paris, France.

DIAGNOSIS AND RELATIONSHIP

T. astriatoides n. sp. is characterized by having a striated lip region, irregularly areolated lateral fields throughout the body and oesophageal glands overlapping the intestine.

Because of the presence of oesophageal overlap the new species comes close to *T. falciformis* Whitehead, 1960, *T. rectangularis* Netscher & Germani, 1969, *T. rhopalocercus* (Seinhorst, 1963) Seinhorst, 1968 and *T. astriatus* Khan & Nanjappa, 1971. However, it differs

Table 2. Dimensions of five species of *Trichotylenchus* (all measurements in µm, except L).

	T. astriatoides n. sp.			*T. astriatus*		*T. falciformis*		*T. rhopalocercus*		*T. rectangularis*	
	Females (paratype)	Males (paratype)	Holotype (female)	Females	Males	Females	Males	Females	Males	Females	Males
n	5	4	1	20	10	9	3	5	5	7	6
L (mm)	0.56-0.68 (0.62 ± 0.04)	0.53-0.64 (0.60 ± 0.04)	0.60	0.49-0.66 (0.57)	0.49-0.60 (0.54)	0.67-0.91	0.69-0.74	0.62-0.81	0.62-0.73	0.77-0.9	0.68-0.76
a	31-35 (34 ± 2.5)	30-32 (31 ± 1.2)	33	22-32 (27)	24-33 (28.5)	36-46	47-50	38-46	39-43	32-37	33-43
b	4.7-5.4 (5.0 ± 0.29)	4.6-4.8 (4.7 ± 0.29)	4.9	4-6 (5)	4.5-6.0	4.4-7.1	5.6-6.5	6.5	5.3-5.6	5-6	5.3-6.5
b′	4.6-5.1 (4.9 ± 0.27)	4.5-4.9 (4.6 ± 0.29)	4.7	–	–	–	–	–	–	–	–
c	11-12.4 (12 ± 0.43)	16.1-16.4 (16.2 ± 0.25)	11.4	11-17 (14)	14-17 (15.5)	10.7-12.5	12.2-12.4	11-13	15-17	13-15	14-16
c′	3.9-4.8 (4.2 ± 0.2)	2.3-2.6 (2.4 ± 0.15)	4.1	2.5-4.0 (3.2)	2.5-3.0 (2.7)	5.0-7.1	5.3-6.6	–	–	–	–
V	54-56 (55 ± 0.78)	–	56	50-60 (55)	–	49.4-60	–	49-55	–	48-53	–
Stylet	22.5-24 (23 ± 0.79)	22.5-24 (23 ± 0.75)	22.5	20-23	20-23	17-25	18-20	17-19	18-19	19-21	17-18
Conus	10.5	10.5	10.5	10	–	–	–	–	–	–	–
O	6.0-6.6 (6.2 ± 0.16)	6.2-6.6 (6.35 ± 0.19)	6.4	–	–	–	–	–	–	–	–
Ant. end to nerve ring	90-95 (92.2 ± 2.0)	89-94 (92 ± 2.1)	92	–	–	–	–	–	–	–	–
Ant. end to excret. pore	94-103 (97.6 ± 4.7)	96-99 (97.5 ± 1.2)	97.5	–	–	Not seen	–	–	–	92-108	80-100
Post-anal sac	12-13.5 (12.7 ± 0.8)	–	12	–	–	absent	–	–	–	–	–
Tail	47-55.5 (51.7 ± 3)	36-39 (37.8 ± 1.4)	52.5	35-52	–	–	–	–	–	50-62	43-54
Spicules	–	21	–	–	24	–	15-18	–	–	–	18-22
Gubernaculum	–	10.5	–	–	10-11	–	8-10	–	8	–	10-11
Bursa	–	60-68 (64 ± 3.8)	–	–	–	–	–	–	–	–	–

from all these species in having irregularly areolated lateral fields. It further differs from the closest species *T. astriatus* in having a striated lip region, lateral fields areolated along entire body length, in the shape of stylet knobs, in having a striated tail tip and slightly smaller spicules (lip region unstriated, lateral fields areolated only in the metacorpal region, spear knobs anteriorly cupped, tail tip unstriated in *T. astriatus*). It differs from *T. rectangularis* in having a smaller body, longer stylet, in the nature of oesophageal overlap, smaller c value and posterior vulva (lateral fields completely and regularly areolated and the entire oesophageal bulb overlaps the intestine in *T. rectangularis*). From *T. falciformis* it differs in having a smaller body, longer stylet, in the nature of oesophageal overlap, longer spicules and higher c value in males (lateral fields without areolation, oesophageal overlap starts immediately below median bulb in *T. falciformis*). From *T. rhopalocercus* it differs in having a smaller body, in the nature of oesophageal overlap, longer stylet and gubernaculum (lateral fields areolated in anterior end and posterior to phasmids only and oesophagus very slightly overlapping the intestine in *T. rhopalocercus*).

***Merlinius macrodens* (Allen, 1955) Siddiqi, 1970**
(Figs 3 A-E; 4 A-G)

DIMENSIONS

Females (n = 10) : L = 1.14-1.33 (1.23 ± 0.06) mm; a = 30-36 (34 ± 1.8); b = 5.6-6.6 (6.2 ± 0.3); c = 13.0-15.9 (14.1 ± 0.98); c′ = 2.44-2.82 (2.62 ± 0.15); V = 52.1-58.4 (54 ± 2.0); stylet = 40-48 (43 ± 2.5) µm; conus = 15.5-19.5 (17 ± 1.3) µm.

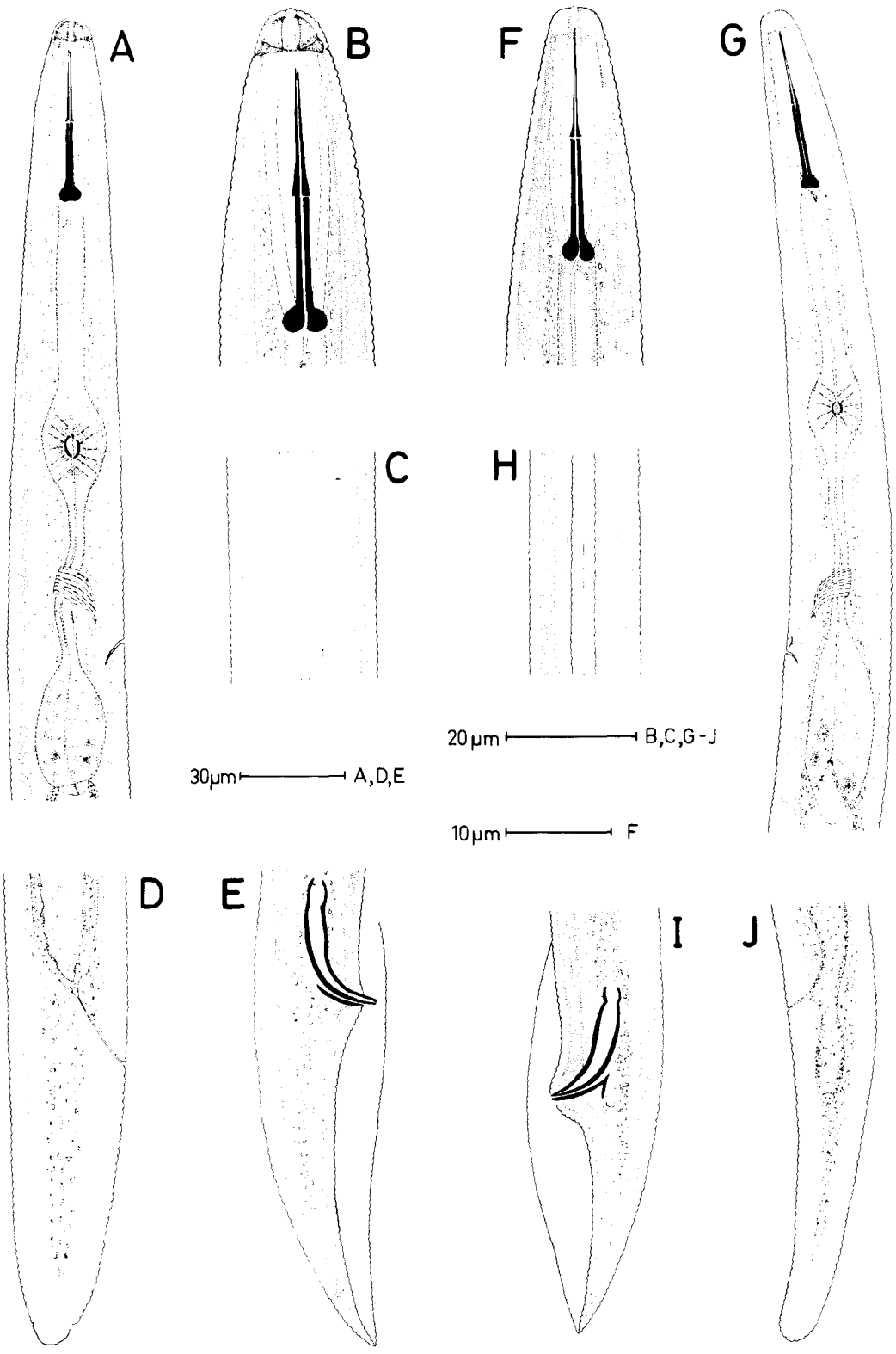

Fig. 3. A-E : *Merlinius macrodens* (Allen, 1955) Siddiqi, 1970. A : Oesophageal region; B : Anterior region; C : Lateral field; D : Female tail; E : Male tail. — F-J : *Trichotylenchus astriatoides* n. sp.; F : Anterior region; G : Oesophageal region; H : Lateral fields; I : Male tail; J : Female tail.

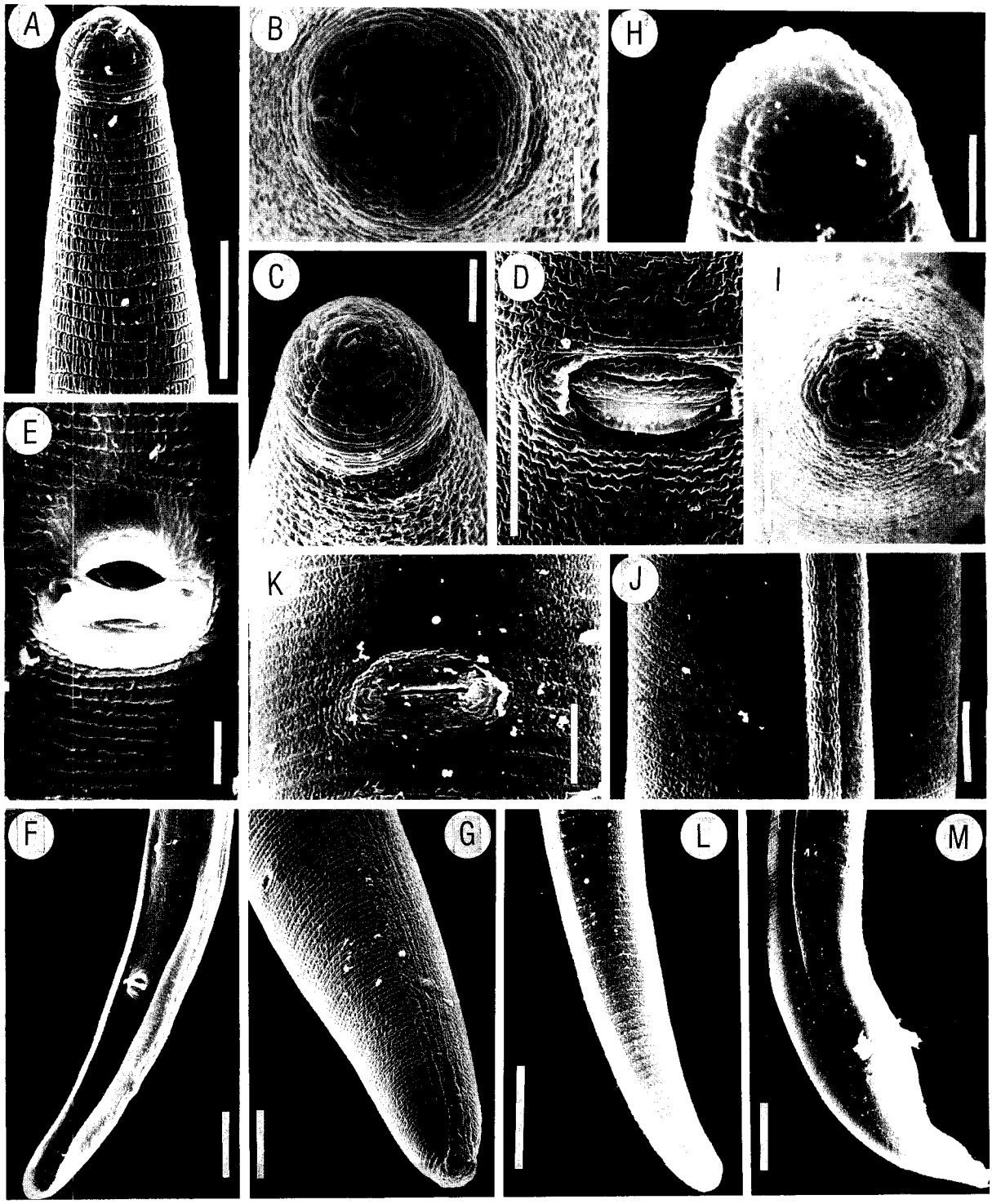

Fig. 4. A-G : *Merlinius macrodens* (Allen, 1955) Siddiqi, 1970. A : Anterior region; B : Face view; C : Anterior end; D : Vulva; E : Cloaca; F : Male posterior region; G : Female tail. — H-M : *Trichotylenchus astriatoides* n. sp.; H : Lip region; I : Face view; J : Lateral field (midbody); K : Vulva; L : Female tail; M : Male posterior region. *(Bars equivalent : F = 20 µm; A, D, G, L, M = 10 µm; B, C, E, I, J, K = 3 µm; H = 2 µm.)*

Males (n = 4) : L = 1.18-1.37 (1.29 ± 0.08) mm; a = 36-42 (40 ± 2.5); b = 5.8-6.7 (6.3 ± 0.37); c = 11.1-12.1 (11.7 ± 0.42); c' = 3.67-3.85 (3.81 ± 0.14); stylet = 41-47 (42 ± 0.8) µm; conus = 18 µm; spicules = 44-49 (46 ± 2.8) µm; gubernaculum = 13.7-15.3 (14.9 ± 0.8) µm; bursa = 170-210 (189 ± 22) µm.

DESCRIPTION

Female : Cuticle transversely striated, each stria about 1.5-2.0 µm apart at midbody. Lateral fields with six incisures, areolated in the anterior region but smooth on rest of body, originating at base of spear and terminating at the tail tip. Lip region rounded, set off by a constriction, 11-12 µm wide and 6-7 µm high with 7-8 fine annules. Anterior four labial annules divided by longitudinal furrows into six sectors, the laterals distinctly narrower than the submedians. Lips amalgamated, oral aperture small, elliptical. Labial plate squarish with rounded corners, 4.0 µm wide. Amphidial apertures small, elliptical, dorso-ventrally oriented, about 1.5 µm wide. Cephalic framework strongly sclerotized. Stylet strong, conus pointed, about 40-45 % of stylet length. Knobs rounded, 7.5 µm wide across. Orifice of dorsal oesophageal gland about 3 µm behind spear base. Oesophagus 180-230 µm long, procorpus 45-50 µm long, gradually enlarging to a muscular oval median bulb. Median bulb 24-27 µm long with 6-7 µm long valve plates. Isthmus slender about the length of procorpus. Posterior bulb slightly oval with flat base, 35-39 µm long. Cardia conoid, 3.0-4.5 µm long. Excretory pore near the anterior end of basal bulb, 150-180 µm from anterior end. Hemizonid not visible. Gonads amphidelphic, outstretched. Vulva a transverse slit, 12-14 µm wide, 3-4 µm long epiptygma present. Vagina strongly sclerotized. Uterus with proximal glandular and distal muscular part, spermatheca round, oocytes arranged in two rows. Tail 81-95 µm or 2.4-2.8 anal body widths long, tapering gradually to a bluntly conoid tip. Anus pore-like, phasmids small located at 30-35 µm posterior to anus.

Male : Spicules arcuate, strongly developed. Capitulum elongate, oval in shape. Gubernaculum simple, arcuate. Cloacal aperture oval, slightly raised from body contour divided into two parts by the presence of additional fold over this region. The fold itself appears to have two sets of horns. Anterior pair of horns narrow and attached to the lateral margins of cloacal opening, posterior pair of horns wider, apparently free and appear to curve over the posterior half of the cloacal aperture. Being concave in the middle and attached at the sides, these flaps appear to be a broad saddle-like structure (Fig. 4 E). Tail 101-120 µm long, conoid.

HABITAT AND LOCALITY

Soil around roots of forest tree (unidentified) from Rohtang Pass (alt. 4500 m), Himachal Pradesh, India.

REMARKS

The present specimens conform to the dimensions and description of *Tylenchorhynchus macrodens* (= *Merlinius macrodens*) as given by Allen, 1955 except for having a slightly longer body and a greater b value. In face view the shape of labial disc and the six sectored labial region appears quite similar to that of *M. grandis* (Powers, Baldwin & Bell, 1983). Further, Powers, Baldwin and Bell (1983) observed that the labial region of *M. grandis, M. conicus, M. superbus* and *M. macrodens* was divided into sectors by the presence of complete longitudinal striations. In the present specimens, though the labial region is divided into sectors the longitudinal striations are restricted to the anterior four annules only and in this aspect it may resemble the lip region of *M. affinis* and *M. lineatus* (Powers, Baldwin & Bell, 1983).

Acknowledgments

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References

ALLEN, M. W. (1955). A review of the nematode genus *Tylenchorhynchus*. *Univ. Calif. Publs Zool.*, 61 : 129-166.

DE GUIRAN, G. & GERMANI, G. (1968). *Brachydorus tenuis* n. g., n. sp. (Nematoda : Dolichodorinae) associé à *Ravenala madagascariensis* sur la côte est malgache. *Nematologica*, 14 : 447-452.

KHAN, E. & NANJAPPA, C. K. (1971). *Trophurus similis* sp. n. and *Trichotylenchus astriatus* sp. n. (Nematoda : Tylenchoidea) from Mysore, India. *Indian J. Nematol.*, 1 : 75-79.

KOSHY, P. K., RASKI, D. J. & SOSAMMA, V. K. (1981). *Brachydorus swarupi* sp. n. (Nematoda : Dolichodorinae) from soil around roots of arecanut palm in Kerala state, India. *J. Nematol.*, 13 : 401-404.

LUC, M. & FORTUNER, R. (1987). A reappraisal of Tylenchina (Nemata). 5. The family Dolichodoridae Chitwood, 1950. *Revue Nématol.*, 10 : 177-181.

NETSCHER, C. & GERMANI, G. (1969). *Telotylenchus baoulensis* n. sp. et *Trichotylenchus rectangularis* n. sp. (Nematoda : Tylenchida). *Nematologica*, 15 : 347-352.

POWERS, T. O., BALDWIN, J. G. & BELL, A. H. (1983). Taxonomic limits of the genus *Nagelus* (Thorne & Malek, 1968) Siddiqi, 1979 with a description of *Nagelus borealis* n. sp. from Alaska. *J. Nematol.*, 15 : 582-593.

RASKI, D. J. & LUC, M. (1988). SEM data on *Brachydorus swarupi* Koshy, Raski & Sosamma, 1981 and considerations on the taxonomic position of the genus *Brachydorus* de Guiran & Germani, 1968 (Nemata : Dolichodoridae). *Revue Nématol.*, 11 : 365-368.

SEINHORST, J. W. (1963). Five new *Tylenchorhynchus* species from West Africa. *Nematologica*, 9 : 173-180.

WHITEHEAD, A. G. (1960). *Trichotylenchus falciformis* n. g., n. sp. (Belonolaiminae n. subfam : Tylenchida Thorne, 1949) an associate of grass roots (*Hyparrhenia* sp.) in Southern Tanganika. *Nematologica*, 4 : 279-285.

Nematologica 37 (1991): 376-381, E. J. Brill, Leiden

A NEW SPECIES OF THE RARE NEMATODE GENUS *TRACHYPLEUROSUM* ANDRÁSSY, 1959 (NEMATODA: ACTINOLAIMIDAE) FROM INDIA

BY

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Trachypleurosum indicum n. sp. is described and illustrated. It has a 1.49-1.97 mm long body, a = 36-43; b = 3.7-4.7; c = 11-15; V = 49-54; odontostyle = 18-21 µm; spicules = 37-45 µm and is characterized by rugose cheilostomal walls and a short odontostyle.

Keywords: Dorylaimida, Actinolaimidae, *Trachypleurosum indicum* n. sp.

Thorne (1939) erected the genus *Trachypleura* with *T. conformis* (W. Schneider, 1935) as its type species and also included *T. labyrinthostoma* (Cobb, 1893). Andrássy (1959) changed the name to *Trachypleurosum* because *Trachypleura* Thorne, 1939 was preoccupied. Thorne (1967) proposed the family Trachypleurosidae for *Trachypleurosum* while Vinciguerra (1988) considered it only a subfamily under Actinolaimidae. Recently Coomans *et al.* (1990) revised the genus and found that the onchia were present in *Trachypleurosum* which was originally described without onchia. They also synonymized the subfamily Trachypleurosinae with Actinolaiminae which is justified because presence of sexual dimorphism in tail shape is a plesiomorphy and cannot be used in separating subfamilies; except for sexual dimorphism in tail shape the genus *Trachypleurosum* is similar to the genera of Actinolaiminae. Coomans *et al.* (1990) also described a new species *Trachypleurosum venezolanum* and considered *T. labyrinthostoma* as *species incertae sedis*.

In a recent survey of soil nematodes from Assam, India, several populations of actinolaimid nematodes were collected. One of these yielded a new species of the rare nematode genus *Trachypleurosum* which is described here as *T. indicum* n. sp. This is the third species of this genus; the other two known species, *T. conformis* and *T. venezolanum* are known from Ivory coast, West Africa and from Venezuela, respectively.

MATERIALS AND METHODS

Specimens for light microscopy were killed and fixed in hot 4% formalin, dehydrated by the slow method and mounted in glycerine. Measurements

were made with an ocular micrometer. For SEM, formalin fixed specimens were washed in buffer, fixed in osmium tetroxide, dehydrated in an alcohol series and critical point dried in CO_2. Dried specimens were mounted on aluminium stubs, coated with 30 nm gold and observed in a Hitachi S 2300 SEM at 15 KV.

DESCRIPTION

Trachypleurosum indicum n. sp.
(Fig. 1 & 2)

Dimensions: Table I.

Adults: Body straight to slightly ventrally curved upon fixation, more so in posterior end especially in males. Cuticle finely striated, 2-3 µm thick at mid-body and 3-4 µm at tail. Each stria 1.5-2.0 µm apart at midbody. Lateral chords starting as a narrow strand near base of odontostyle and gradually expanding to become about 1/3rd of body width at midbody. Lateral body pores irregularly arranged throughout body; dorsal body pores three, confined to odontostyle-odontophore region; ventral body pores 5-6 restricted to the region anterior to nerve ring. Lip region offset by expansion with rounded sides, about twice as wide as high. Oral aperture circular. On the inside of the lips is a hexagonal ring with 33-34 rugae. Anterior sensilla not discernible. Amphids cup-shaped, aperture 7.5-10.5 µm or about half of corresponding body width. Odontostyle 1.0-1.2 lip region widths long with aperture about 1/3rd its length. Guiding ring double, fixed ring at 0.7-0.8 lip region width from anterior end. Odontophore rod-like, posterior end difficult to delimit from oesophageal lumen. Vestibular ring dentate forming a crown with 33-34 prongs around oral opening. Cheilostome with four onchia and rugose walls. Cheilostomal denticles absent. Nerve ring at 133-159 µm from anterior end. The oesophagus begins to widen at 46-57% and attains its full width at 51-65% of its length from head end. Cardia conoid, 18-24 µm long. Cardiac disc present. Oesophageal gland nuclei and their orifices located as follows:

DO = 53-56	S_1N_1 = 77-79	S_2N = 87-89
DN = 55-58	S_1N_2 = 79-81	S_2O = 88-90
DO-DN = 1.7-2.4.		

Female: Reproductive system amphidelphic, both the branches equally developed. Ovaries well developed, 72-79 µm long. Uterus 100-123 µm long, median muscular part containing Z-differentiation, pars dilatata not well defined. Oviduct 101-145 µm long with well developed pars dilatata. Vulva irregular in shape with lips almost covering the aperture which is about 5 µm. Vagina 15-16 µm or about 1/3rd of corresponding body width. Anal aperture crescent-shaped, 5-6 µm wide. Rectum 31-37 µm or 1.1-1.2 anal body widths long. Prerectum 2.6-3.5 anal body widths long. Tail dorsally convex-conoid

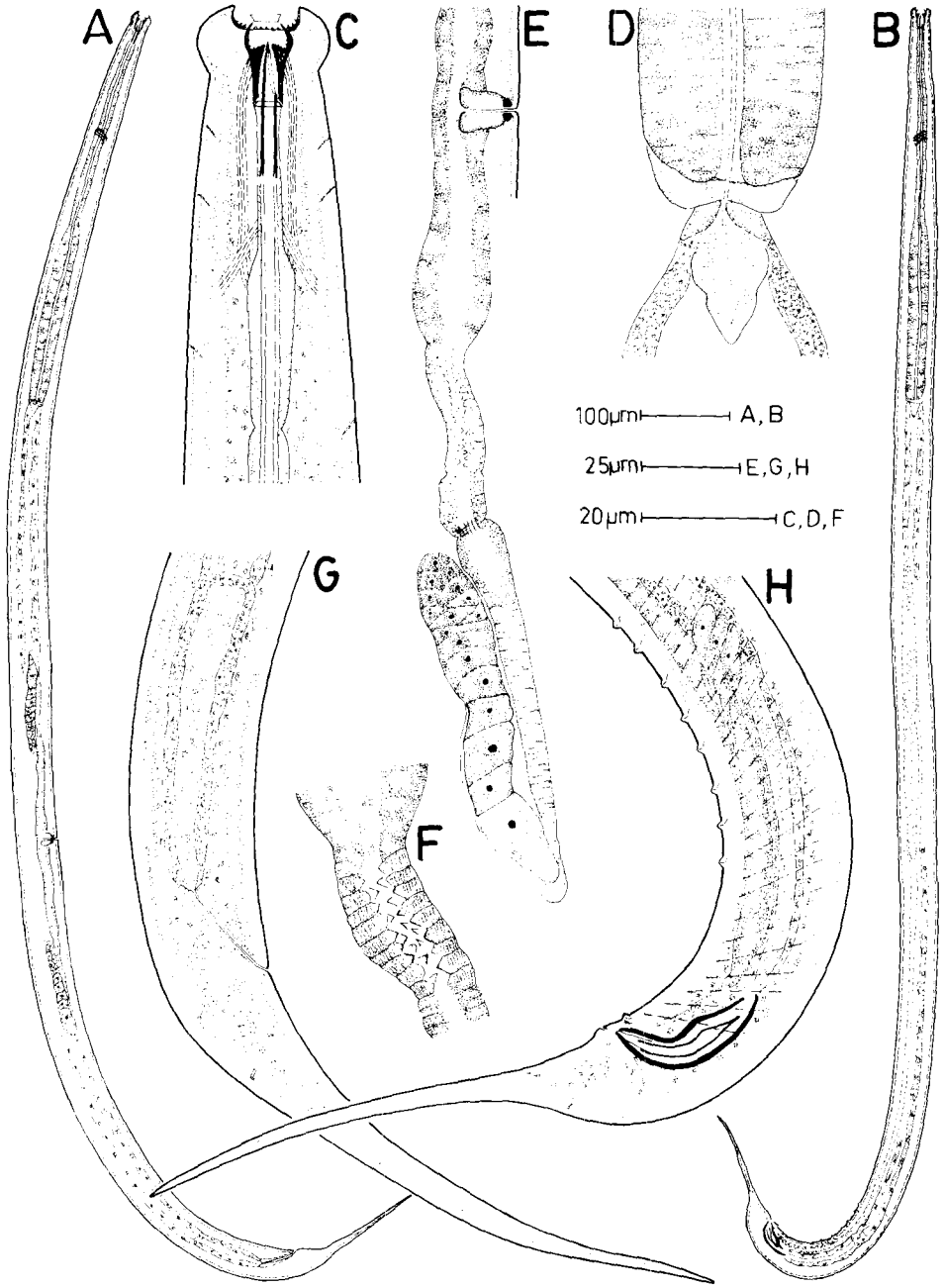

Fig. 1. *Trachypleurosum indicum* n. sp. A, Entire female; B, Entire male; C, Anterior region; D, Oesophago-intestinal junction; E, Female gonad (posterior); F, Part of uterus with Z-differentiation; G, Female posterior region; H, Male posterior region.

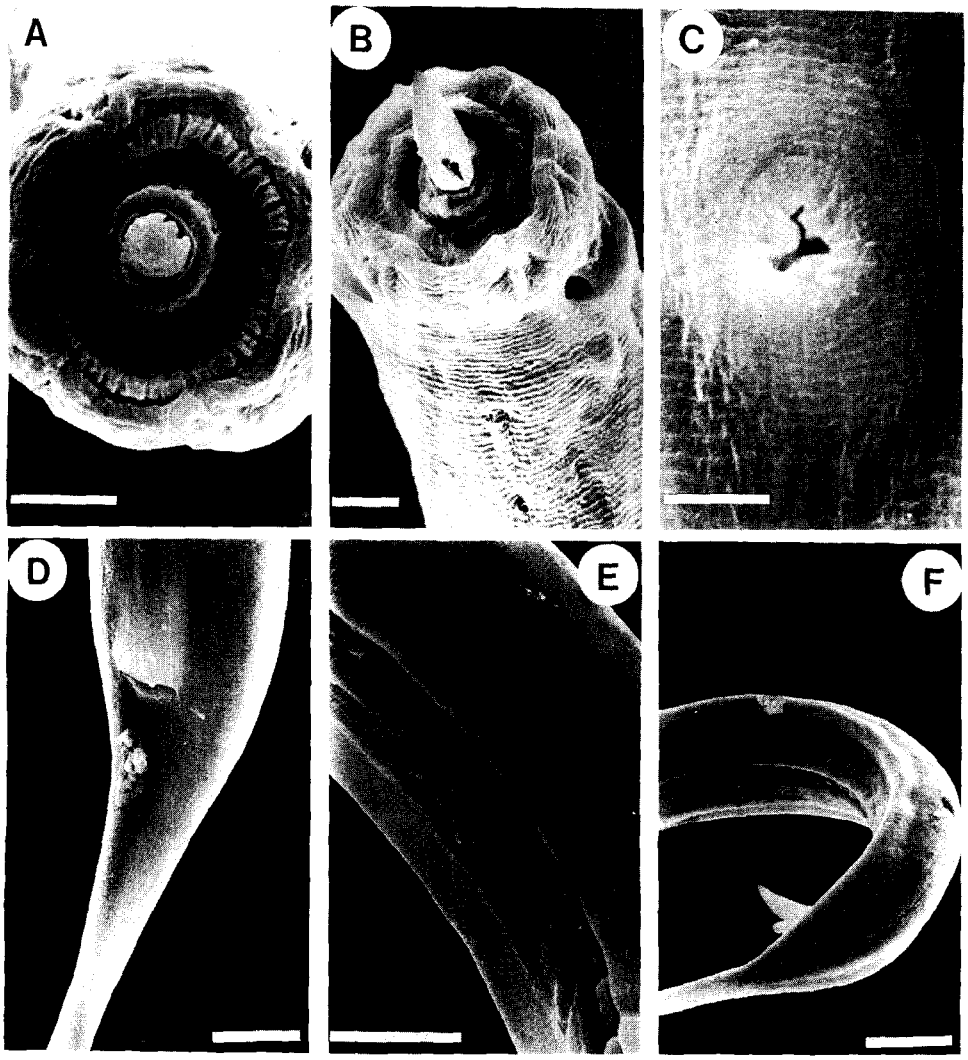

Fig. 2. *Trachypleurosum indicum* n. sp. A, En face; B, Anterior region; C, Vulval region; D, Anal region (female); E, Ventromedian supplements; F, Male posterior region (Scale: Bar = 3 μm in A-C; 10 μm in D, E and 20 μm in F).

then gradually tapering to become long filiform, 4-6 anal body widths long with a pair of caudal pores on each side.

Male: Testes paired, opposed, dorylaimoid, sperm spindle shaped, 5-6 μm long. Spicules dorylaimoid, 1.4-1.5 anal body widths long. Lateral guiding pieces rod-like, about 1/5th of spicules length. Supplements an adanal pair and 7-9 regularly spaced ventromedians. The posterior supplement at 45-51 μm from cloacal aperture, others 8-9 μm apart. Prerectum 2.7-3.6 anal body widths long. Tail dorsally convex-conoid then suddenly tapering to become

TABLE I

Dimensions of Trachypleurosum indicum *n. sp.*

	Holotype female	Paratype females (n = 10) Range	Mean	S.D.	Paratype males (n = 6) Range	Mean	S.D.
Length (mm)	1.76	1.59-1.97	1.81	0.11	1.49-1.65	1.57	0.07
a	39.56	36.25-43.78	39.36	2.26	37.53-43.19	40.37	2.11
b	3.96	3.74-4.71	4.33	0.31	3.73-4.15	3.92	0.16
c	11.58	11.49-15.21	13.09	1.26	12.08-12.77	12.62	0.73
c′	5.63	4.26-6.11	5.18	0.53	3.73-4.64	4.32	0.31
V/I	54.19	48.91-54.44	53.81	2.42	46.29-60.44	51.25	5.79
G_1	13.39	9.78-15.98	12.47	2.08	12.42-16.24	14.11	1.65
G_2	13.17	8.05-14.81	11.71	2.29	14.41-17.80	15.51	1.55
Odontostyle (μm)	19.50	18.00-21.00	20.15	1.37	18.00-19.50	19.25	0.61
Odontophore (μm)(?)	30.00	25.50-33.00	30.45	2.35	25.50-30.00	28.00	2.25
Odontophore region (μm)	37.50	36.00-42.00	37.67	1.75	35.00-37.50	36.10	0.89
Lip region width (μm)	18.00	18.00-21.00	18.75	1.06	18.00-19.50	18.75	0.82
Lip region height μm)	7.50	7.50-9.00	8.70	0.63	9.00		
Oesophagus (μm)	444.60	391.40-444.60	425.68	15.02	368.60-418.00	400.90	17.12
Cardia (μm)	24.00	18.00-24.00	20.83	2.04	16.50-24.00	21.25	3.91
Prerectum (μm)	69.00	69.00-97.50	83.55	9.27	67.50-91.50	81.66	14.76
Rectum (μm)	37.50	30.00-37.50	33.30	2.62	30.00-37.50	34.00	3.09
Tail (μm)	152.00	121.60-155.80	139.52	13.97	106.40-133.00	124.13	9.51
ABD (μm)	27.00	24.00-30.00	27.00	1.73	27.00-30.00	28.75	1.12
Spicules (μm)					37.50-45.00	41.25	2.46
Lateral guiding pieces (μm)					7.50-12.00	9.30	1.95
Ventromedian supplements					7-9		

long filiform, 4-5 anal body widths long with 3-4 caudal pores on each side.

Type habitat and locality: Rhizosphere of grasses (unidentified) from Haflong, Assam, India.

Type specimens: Collected in March 1990; holotype female and a paratype male on slide *Trachypleurosum indicum* n. sp./1. Other paratype males and females on slides *Trachypleurosum indicum* n. sp./2-7 deposited in the nematode collection of Zoology Department, Aligarh Muslim University, Aligarh. A paratype female and a male deposited at Instituut voor Dierkunde, Gent, Belgium.

Differential diagnosis: Trachypleurosum indicum n. sp. differs from *T. conformis* (W. Schneider, 1935) Andrássy, 1959 in having a smaller body, odontostyle and spicules, fewer ventromedian supplements and longer tail (L = 2.15 mm; c = 18.2; c′ = 3.9; odontostyle = 24 μm in females and L = 2.29 mm; c = 20.8; c′ = 3.2; spicules = 50 μm; ventromedian supplements 15 in males, in *T. conformis*). From *T. venezolanum* Coomans, Vinciguerra & Loof, 1990 it differs in having rugose cheilostomal walls, narrower lip region, shorter and wider odontostyle and smaller spicules (cheilostomal wall not rugose, lip region 22-26 μm wide, odontostyle 26-31 μm and spicules 46-52 μm in *T. venezolanum*).

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RÉSUMÉ

Une nouvelle espèce du genre rare, Trachypleurosum *Andrássy, 1959 (Nematoda: Actinolaimidae) provenant de l'Inde*

Trachypleurosum indicum n. sp. est décrit et illustré. Il est caractérisé par: L = 1,49-1,97 mm; a = 36-43; b = 3,7-4,7; c = 11-15; V = 49-54; odontostyle = 18-21 µm; spicules = 37-45 µm. Il se différencie par les parois rugeuses du cheilostome et le court odontostyle.

REFERENCES

Andrássy, I. (1959). Neubenennungen einiger homonyonen Nematoden-Gattungen. *Nematologica* **4**, 223-226.

Coomans, A., Vinciguerra, M. T. & Loof, P. A. A. (1990). Status of the genera *Paractinolaimus* Meyl, 1957, *Trachypleurosum* Andrássy, 1959 and *Trachactinolaimus* Andrássy, 1963 (Nematoda: Actinolaimidae) with description of *Trachypleurosum venezolanum* n. sp. *Revue de Nématologie* **13**, 143-154.

Thorne, G. (1939). A monograph of the nematodes of the superfamily Dorylaimoidea. *Capita Zoologica* **8**, (5), 1-261.

Thorne, G. (1967). Nematodes of Puerto Rico: Actinolaimoidea new superfamily with a revision of its genera and species with addenda to Belondiroidea (Nemata, Adenophorea, Dorylaimida). *University of Puerto Rico Agricultural Experimental Station* Technical paper **43**, 48 p.

Vinciguerra, M. T. (1988). A new classification of Actinolaimoidea Thorne, 1939, using a cladistic approach. *Nematologica* **33** (1987), 251-277.

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DESCRIPTION OF *PARATIMMINEMA BREVIBULBUM* N. GEN., N. SP. AND *ROQUEUS INDICUS* N. SP. (DORYLAIMIDA: THORNENEMATIDAE) FROM ANDAMANS, INDIA

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Paratimminema brevibulbum n. gen., n. sp. and *Roqueus indicus* n. sp. are described and illustrated. *Paratimminema* n. gen. is characterised by the presence of labial and post-labial sclerotization, a short expanded part of the oesophagus and a double gonad. It differs from *Sclerolabia* Carbonell & Coomans, 1986 in the presence of double gonad and from *Willinema* Baqri & Jairajpuri, 1967 in the presence of labial and post-labial sclerotization. *Roqueus indicus* n. sp. differs from R. gracilis Thorne, 1964, the only known species in this genus, by having a shorter body, shorter odontophore, lesser 'b' value, more posterior vulva and a shorter tail.

Keywords: taxonomy, soil nematode, *Paratimminema brevibulbum* n. gen., n. sp. *Roqueus indicus* n. sp. India.

Khan (1977) described a thornenematid nematode genus *Timminema* from Sind, Pakistan, with *T. pakistanicum* as its type species. He differentiated *Timminema* from *Willinema* Baqri & Jairajpuri, 1967, the most closely related genus, mainly in the presence of a double gonad as against single in *Willinema*. The original description and illustrations of *Timminema pakistanicum* are very poor and totally inadequate to identify any nematode species. The type material was also never made available for study nor was the species ever collected again. Because of inadequate description and the unavailability of the type, Coomans & Carbonell (1988) rightly considered *Timminema* a *genus inquirendum*. Jairajpuri & Ahmad (1992) also doubted the validity of this genus.

Recently, in a soil sample collected from the Andaman Islands we came across a few specimens of a thornenematid nematode having labial and post-labial sclerotization and a double gonad. These specimens appear close to the vague description of *Timminema* whose validity is doubtful and the type specimens do not exist. The placement of the species under the dubius genus *Timminema* would not be logical nor correct and hence a new genus *Paratimminema* is proposed to accommodate this species. The new genus is also distinctive in having a very short expanded part of the oesophagus.

Thorne (1964) described an interesting belondirid nematode genus *Roqueus* from El Yunque Rain Forest, Puerto Rico. The genus is characterized by the presence of a long slender body showing sexual dimorphism in the tail shape, a small odontostyle, a short oesophageal bulb enclosed in a spiral muscular

sheath, a complicated cardia and amphidelphic female reproductive system. In the present paper a second species of the genus is described from India viz. *Roqueus indicus* n. sp.

PARATIMMINEMA N. GEN.

Diagnosis: Thornenematinae. Small nematode (0.4-0.6 mm). Lip region narrow, offset by depression, abruptly narrower than the adjoining body. Labial and post-labial sclerotization well developed. Labial papillae distinct. Amphids cup-shaped with slit-like aperture. Odontostyle cylindroid, straight dorsally and its ventral side with slight dorsal bend at the level of the aperture. Guiding ring single. Odontophore rod-like. Expanded portion of oesophagus a short, cylindroid bulb, 29-31% of total oesophageal length. Cardia short, hemispheroid. Female reproductive system amphidelphic. Vulva post-equatorial. Vagina without distal sclerotization. Tail short, hemispheroid. males not found.

Type species: *Paratimminema brevibulbum* n. gen., n. sp. *Relationship*: *Paratimminema* n. gen. fits the definition of Thornenematinae (Coomans & Carbonell, 1988) because of the presence of labial and post-labial sclerotization and the position of S_2N and S_2N and S_2O. From among the genera presently placed under Thornenematinae it differs from *Thornenema* Andrássy, 1959 and *Sicaguttur* Siddiqi, 1971 mainly because of the presence of a short tail in both sexes. It comes close to *Sclerolabia* Carbonell & Coomans, 1986 but differs in the presence of an amphidelphic female reproductive system and in having a very short expanded part of the oesophagus (female reproductive system mono-opisthodelphic and expanded portion of oesophagus usually about 1/3rd of the total neck length in *Sclerolabia*). The new genus is also related to *Willinema* Baqri & Jairajpuri, 1967 but differs from it in the presence of labial and post-labial sclerotization and in having an amphidelphic female reproductive system (labial and post-labial sclerotization absent and female reproductive system mono-opisthodelphic or pseudo-mono-opisthodelphic but the anterior branch is never functional in *Willinema*). *Paratimminema* n. gen. closely resembles *Sclerolabia* except for the female gonad being amphidelphic as against monodelphic in *Sclerolabia*. Among thornenematids the development of an anterior gonad is highly variable although it is very rarely functional. In *Thornenema*, *Indodorylaimus*, *Willinema*, *Opisthodorylaimus* etc. the anterior branch shows various degrees of development but it is never functional except in *Sicaguttur* where there is a true amphidelphic condition. In all the five known species of *Sclerolabia* the anterior branch is represented by a small anterior uterine sac where as in *Paratimminema* n. gen. a true amphidelphic condition is found with both the branches equally developed and functional.

Paratimminema brevibulbum N. SP.
(Fig. 1)

Dimensions

Holotype female: L=0.5 mm; a=0.5 mm; a=19; b=3.8; c=31; c'=1.0; V=58; G_1=16; G_2=16; odontostyle=11 µm; odontophore=15 µm; oesophagus=134 µm; prerectum=36 µm; rectum=21 µm; tail=17 µm; ABD=17 µm.

Paratype females (n=8): L=0.4-0.5 (0.5×0.02) mm; a=18-21 (19.5×0.9); b=3.7-3.9 (3.8×0.07) c=25-33 (30×2.7), c'=0.8-1.1 (0.96×0.08); v=56-61 (58.8×1.4); G_1=10-19 (14.1×3.1); G_2=13-17 (15.2×1.3); odontostyle=10-11 (10.6×0.4) µm; odontophore=13.5-15 (14.3×0.7) µm; oesophagus=129-139 (132×139 (132×3.7) µm; prerectum=31-45 (34.6×4.4) µm; rectum=15-21 (18.5×2.4) µm; tail=15-19 (16.8×1.5) µm; ABD=16.5-19.5 (17.6×1.06) µm.

Description

Female: Body slightly ventrally curved upon fixation, tapering gradually towards anterior end. Cuticle finely striated, 1.5 µm thick at mid body and 2.5-3.8 µm on tail. Lateral hypodermal chords about one-third of body width at midbody. Lateral, dorsal and ventral body pores indistinct.

Lip region distinctly narrower than the adjoining body, 6-7 µm wide and 4.5-5 µm high. Labial

and post-labial sclerotization strong. Amphids cup-shaped, aperture 4 µm or baout half of the corresponding body width. Odontostyle cylindrical,1.3-1.7 lip region width long with aperture about one-fourth of its length. Guiding ring single at 5-6 µm or 0.7-0.8 lip region width from anterior end,/Odontophore rod-like, 1.2-1.4 times the odontostyle length. Nerve ring at 51-75 µm from anterior end. Oesophaqus beginning as a slender tube gradually expanding in its posterior third to a short cylindrical bulb. Basal bulb 36-41 µm long and 19-23 µm wide or 29-31% of total oesophageal length. Cardia short conoid, 11-14 µm long or about half the corresponding body width. Oesophageal gland nuclei and their orifices located as follows: DO=69-72; DN+71-75; DO-DN=1.8-2.8; S_1N_1=82-83; S_1N_2=84-85; S_2N1=92-95; S_2O=94-95.

Reproductive system amphidelphic. Vulva transverse, Vagina 10-13 µm deep or about half of the corresponding body width. Both branches equally developed; uterus 42-58 µm and oviduct 32-55 µm long. Oviduct-uterus junction provided with a distinct sphincter. Ovary reflexed, 42-54 µm long with oocytes arranged in a single row except at tip. Prerectum 1.6-2.1 anal body widths long. Tail short, hemispheroid, 0.8-1.0 anal body width long with a pair of caudal pores on each side.

Male: not found

Type habitat and locality: Soil around roots of forest tree (unidentified) from little Andamans, India.

Type specimens: Collected in February 1991; holotype female on slide *Paratimminema brevibulbum* n. sp./1; paratype females on slides *Paratimminema brevibulbum* n. sp./2-5; deposited in the nematode collection of Zoology Department, Aligarh Muslim University, Aligarh. A paratype female deposited at Instrituut voor Dierkunde, Gent, Belgium.

Roqueus indicus N. SP.
(Fig 2 & 3)

Dimensions

Holotype female: L=3.1 mm; a=65; b=9.2; c=15; c'=7; V=42; G_1=13; G_2=14; odontostyle=10 µm; odonto-phore=12 µm; oesophaqus=338 µm; prerectum=171 µm; rectum=36 µm; tail 213 µm; ABD=32 µm.

Paratype females (n=3); L=2.8-3.5 (3.05×0.3) µm; a=54-71 (59.7×7.9); b=9.1-10.6 (9.51×0.8); c=10-16 (13.2×2.3); c'=5.5-10 (7.4×2.0); V=38-49 (43.4×4.4) G_1=9-14 (11.4×1.9); G_2=9-15 (13.1×2.9); odontostyle 9-10 (9.6×0.5) µm; odontophore=12-15 (13.5×1.22) µm; oesophagus 323-338 (328×7.2) µm; prerectum=177-240 (202.3×27.2) µm; rectum=30-36 (32×2.8) µm; tail=182-337 (229.9×54.6) µm; ABD=31-33 (32.5×0.7) µm.

Paratype male (n=1): L=2.5 mm; a=49; b=7.8; c=80; c'=0.9; T=56; odontostyle=9 µm; odontophore=14 µm; oesophagus=327 µm; spicules=51 µm; lateral guiding pieces=12 µm; ventromedian supplements=15; prerectum=180 µm; rectum=45 µm; tail=31.5 µm; ABD=34 µm.

Carnicobar population:

Females (2=4): L=2.6-3.2 (3.1×0.3) mm; a=49-66 (56.7×7.6); b=7.8-9.9 (8.6×0.9); c=12-14 (13.3×0.9); c'=6.5-7.5 (6.9×7.5 (6.9×0.4); V=41-44 (42.9×1.6); G_1=12-15 (13.4×1.2); G_2=13-15 (13.8×1.0); odontostyle=9 µm; odonto-phore=13-15 (14.00.7) µm; oesophagus=315-327 (321×4.9)µm; perrectum=147-202 (178.5×23.1) µm; rectum=30-37 (34.8×3.3) µm; tail=197-228 (209×14.5) µm; ABD=28-33 (30.0×2.1) µm.

Description

Female: Body slightly ventrally curved upon fixation, tapering towards both extremities, posteriorly terminating in a long filiform tail. Cuticle finely striated, 1.5-2.0 µm thick at midbody and 5-6 µm on tail. Lateral chords about one-third of body width at midbody. Lateral, dorsal and ventral body pores indistinct.

Lip region narrow, rounded, offset by slight depression, 9-10 µm wide and 5-6 µm high. Amphids stirrup-shaped, 6.0-7.5 µm or about three-fourths of the corresponding body width. Odontostyle fusiform, about one lip region width long with aperture about one-third of its length.

Guiding ring single, at 7.5-8 µm or 0.7-0.8 lip region width from anterior end. Odontophore rod-like, 1.2-1.6 times odontostyle length. Nerve ring at 112-147 µm from anterior end. Oesophagus beginning as a slender tube gradually expanding in its posterior third to form short cylindrical basal bulb. Basal bulb 66-112 µm or about 20-35% of toatl neck length, enclosed in a thick, dextrally spiral macle sheath. Cardia short, conoid, 17-22 µm or about one-third of the corresponding body width. Oesophageal gland nuclei and their orifices located as follows: DO=82-83; DN=84-85; DO-DN=1.3-3.6; S_1N_1=87-89; S_1N_2=89-90; S_2N=91-94; S_2O=93-95.

Reproductive system amphidelphic. Vulva transverse, vagina distally sclerotized, 25-28 µm deep or about half of the corresponding body width. Both branches equally developed; uterus 145-172 µm and oviduct 121-160 µm long. A distinct spincter preent at the oviduct-uterus junction. Ovary reflexed, 137-166 µm long with oocytes arranged in a single row except at tip. Prerectum 5-7 anal body widths long. Rectum 0.9-1.2 anal body width long. Tail long filiform 5.5-10.2 anal body widths long with a pair of caudal pores on each side.

Male: Supplements consisting of an adanal pair and fifteen regularly spaced ventromedians. Supplement 7-8 µm apart, distal one at 75 µm from cloaca. Spicules dorylaimoid, 1.5 anal body widths long, lateral guiding pieces about on fourth the spicule length. Prerectum 5.4 anal body widths long extending 33 µm beyond the range of supplements. Tail short, conoid, bluntly rounded, 0.9 anal body widths long with a pair of caudal pores on each side.

Type habitat and locality: Soil around roots of forest tree (unidentified) from port Blair, Andamans, India.

Type specimens: Collected in February, 1991; holotype female on slide *Roqueus indicus* n. sp./1; paratype females and male on slides *R. indicus*,/2-7; deposited in the nematode collection of zoology Department Aligarh Muslim University, Aligarh. A paratype female deposited at Instituut Voor Dierkunde, Gent, Belgium.

Differential diagnosis: *Roqueus indicus* n. sp differs from *R. gracilis* Thorne, 1964 in having a smaller and comparatively more robust body, whorter odontophore, smaller :b: value, expanded part of oesophagus enclosed in dextrally spiral muscle sheath, posteriorly located vulva, shorter prerectum and shorter tail (L=6.3 µm; a=117; b=14; c=6.2; V=33; odontophore=20 µm; spiral muscle sheath longitudinal and prerectum 10-12 anal body width long in *R. gracilis*).

DISCUSSION

The genus *Roqueus* Thorne (1964) with *R. gracilis* as its type was described as having a dextrally spiral muscle sheath around the basal expanded part of the oesophagus. *R. africanus* Andrássy (1970) on the other hand was reported with a sinistrally spiral muscle sheath around the basal bulb. Mulk, Coomans & Bagri (1978) synonymized this species with *R. heterurus* (Schuurmans Stekhoven & Tenuissens, 1938) Mulk, Coomans & Baqri, 1978. Ferris & Ferris (1973) described a closely related genus *Lindseyus*, with *L. costatus* as its type, under Roqueuidae Thorne, 1964. Among other differences *Lindseyus* had a sinistral muscle sheath around the basal oesophageal bulb. Dhanchand & Jairajpuri (1980) added a second species *L. indicus* closely related to the type species.

A detailed study of *R. gracilis, R. heterurus* and *L. costatus* by commans & Kheiri (1986) revealed that the oesophageal muscle sheath in the former consisted of longitudinal muscle bands as against sinistrally spiral bands in *R. heterurus* and *L. costatus*. They regarded the basket-like structure around the cheilostome as doubtful and on the basis of the sinistral spiral muscle bands they transferred *R. heterurus* to genus *Lindseyus*.

Our observations on *R. indicus* and *L. indicus* reveal the presence of dextrally spiral muscle in *R. indicus* as against straight longitudinal in *R. gracillis*. In

L. indicus, however, the muscle bands are sinistrally spiral, similar to that of the type species *L. heterurus*. Thus, in all the three known species of *Lindseyus* the muscle bands are sinistrally spiral while in *Roqueus* they may be dextral (*R. indicus*) or straight longitudinal (*R. gracilis*). Other belondirid groups (eg. *Axonchium* and *Belondira*) also show similar variations i.e. dextral or straight muscle bands surrounding the basal part of the oesophagus.

Coomans & Kheiri (1986) proposed three tribes *viz*, Swangeriini, Falcihastini and Roqueuini in the subfamily Swangeriinae, differentiating them mainly on the basis of a spiral muscle sheath around the basal bulb, nature of the cardia and sexual dimorphism in the tail shape. The genera *Swangeria* Thorne (1939) and *Qudsiella* Jairajpuri (1967) under Swangiriini have sinistrally spiral muscles and are with or without a cheilostomal basket; *Falcihasta* Clark (1964) under Falcihastini has dextrally spiral muscles and *Roqueus* and *Lindseyus* under Roqueuini have longitudinal or sinistrally spiral muscle bands, with or without poorly developed cheilostomal basket, and sexual dimorphism in the tail shape. With the addition of *R. indicus* n.sp. Roquenini now includes the species with sinistral and longitudinal as well as dextral spiral muscle bands. The tribes Swangeriini and Falcihastini were mainly differentiated on the basis of this character which could be of considerable generic importance, dextral vs sinistral. In tribe Roqueuini all the three conditions are present, the only difference from the other tribes being the presence of sexual dimorphism in the tail shape (a character again of generic importance).

On the basis of the above observations we are hesitant in accepting the three tribes under Swangeriinae. All the genera could be placed in the subfamily Swangeriinae without differentiating into the tribes as accepted by Jairajpuri & Ahmad (1992).

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RÉSUMÉ

Description d'un nouveau genre et d'une nouvelle espèce de nèmatode Dorylaimide provenant des Iles Andaman (Inde).

Paratimminema brevibulbum n. gen., n. sp. et *Roqueus indicus* n. sp. sont décrits et illustrés. *Paratimminema* n. gen. est caractérisé par la présence de sclérotisations pré- et postlabiales, une portion renflée de l'oesophage courte et une gonade double. Il diffère de *Sclerolabia* Carbonell & Coomans, 1986 par sa gonade double et de *Willinema* Baqri & Jairajpuri, 1967 par la présence des sclérotisations pré- et postlabiales. *Roqueus indicus* n. sp. diffère de *R. gracilis* Thorne, 1964-seule espèce connue dans le genrepar un corps et un odontophore plus courts, une valeur plus faible du coefficient b, une vulve située plus en arrière et une queue plus courte.

REFERENCES

Andrássy, I. (1970). Einige neue Nematodenarten aus West afrikanischen Reisfeldern, *Annales Universitatis Scientiarum Budapestinensis de Rolando Eötvös Nominatae - Sectio Biologica* **11**, 243-254.

Baqri, Q. H. & Jairajpuri, M. S. (1967). Review of the genus *Thornenema* Andrássy, 1959 and proposal of *Willinema* n. gen. *Nematologica* **13**, 353-366.

CARBONELL, E. & COOMANS, A. (1986). *Sclerolabia* n. g. with four new species (Nematoda: Dorylaimoidea). *Nematologica* **31** (1985), 26-43.

COOMANS, A. & KHEIRI, A. (1986). Observations on *Lindseyus costatus* Ferris & Ferris, 1973 with a discussion on its relationships (Nematoda: Belondiridae). *Revue de Nématologie* **9**, 357-367.

COOMANS, A. & CARBONELL, E. (1988). The status of the family Thornenematidae Siddiqi, 1969 (Nematoda: Dorylaimida). *Nematologica* **33**(4), 375-385.

DHANACHAND, CH. & JAIRAJPURI, M. S. (1980). Four new and one known species of Dorylaimida from Manipur, India. *Indian Journal of Nematology* **10**, 152-165.

FERRIS, V. R. & FERRIS, J. M. (1973). *Lindseyus costatus* gen. n. sp. n, and notes on the Roqueidae and Swangerlidae (Nematoda: Dorylaimida). *Proceedings of the Helmintho-logical Society of Washington* **40**, 43-46.

JAIRAJPURI, M. S. & AHMAD, W. (1992). *Dorylaimida Free living, predaceous and plant parasitic nematodes.* E. J. Brill, Leiden, the Netherlands and Oxford & IBH, New Delhi, 458, pp.

KHAN, H. A. (1977). *Timminema pakistanicum* new genus and new species (Nematoda: Dorylaimidae) from Pakistan. *Pakistan Journal of Zoology* **9**, 157-159.

MULK, M. M., COOMANS, A. & BAQRI, Q. H. (1978). A Taxonomic Revision o f the Nematode species described by S. Stekhoven and Teunissens (1938) from National Virunga Park, Zaire Republic III. Belondiridae. *Revue de Zoologie Africaine* **92**, 711-722.

THORNE, G. (1964). Nematodes of puerto Rico: Belonderoidea new superfamily, Leptonchidae Thorne, 1935, and Belonenchidae new family (Nematoda: Adenophorea, Dorylaimida). *University of Puerto Rico Agricultural Experiment Station, Technical Paper* **39**, 51 pp.

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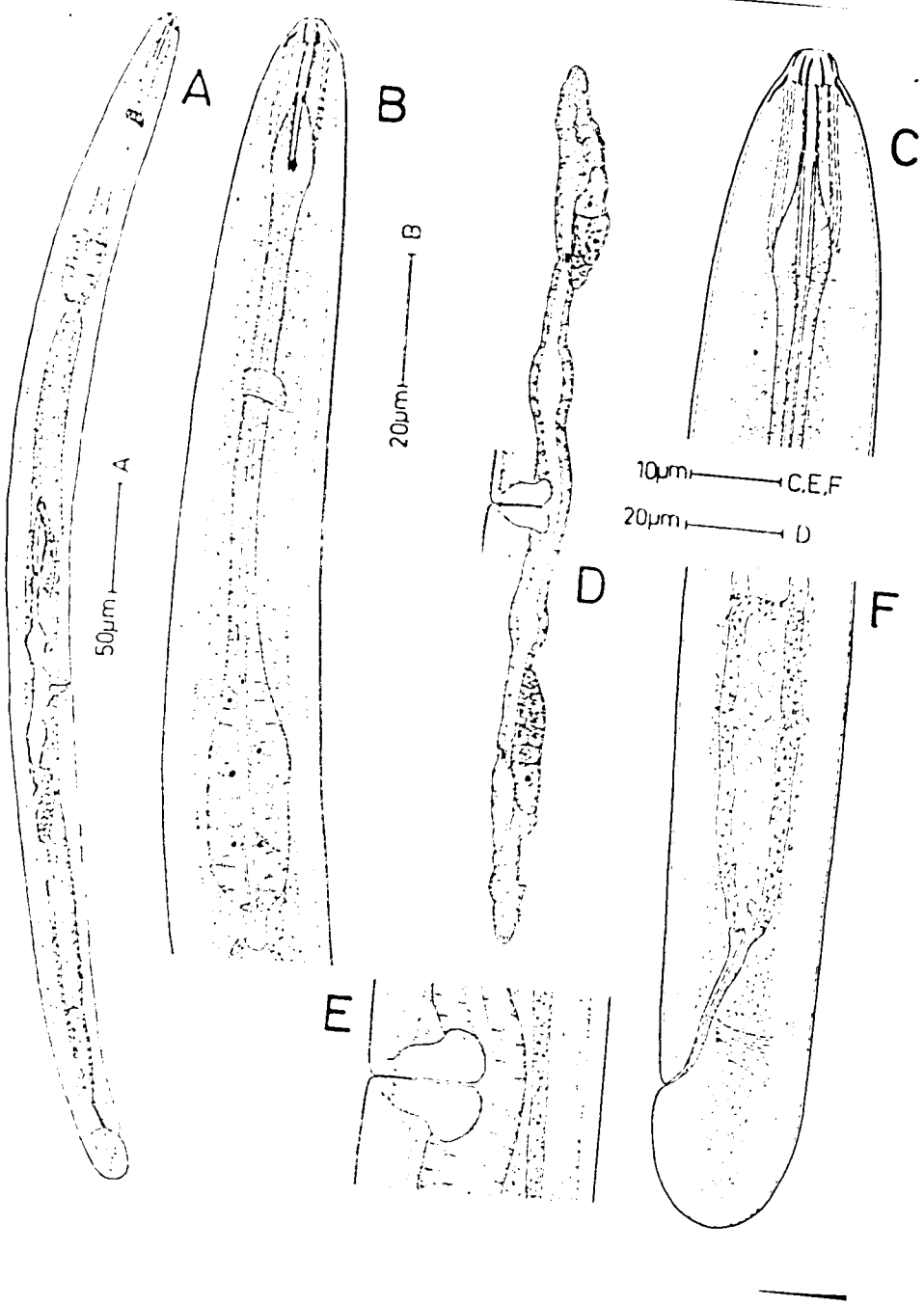
Fig. 1. *Paratimminema brevibulbum* n. gen., n. sp. A - Entire female; B - Oesophageal region; C - Anterior end; D - Female reproductive system; E - Vulval region; F - Posterior region.

Fig. 2. *Roqueus indicus* n. sp.

A - Antire female; B - Entire male; C - Amphideal region; D - Oesophageal region; E - Enterior end; F - Female reproductive system (anterior branch); G - Vulval region; H - Female posterior region; I - Male posterior region.

Fig. 3. *Roqueus indicus* n. sp.

A - Enface view; B, C - Anterior region; D - Female anal region. (Scale bar; 1 µm - A; 2 µm - B, C; 10 µm - D).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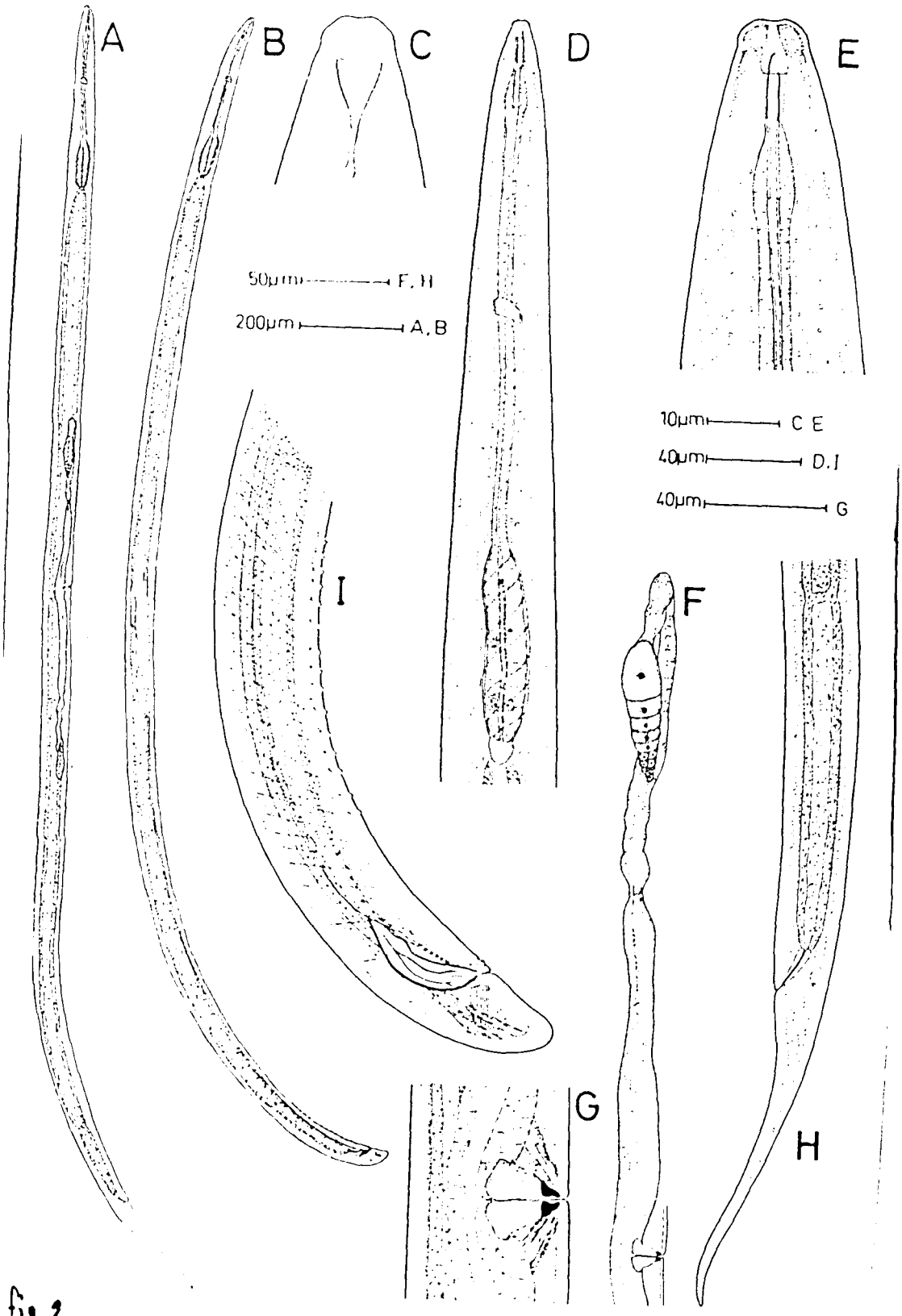

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